AS 1.9/4:24/22
OLUME 24 / NUMBER 22
OVEMBER 23, 1986
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59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL) 3502

60 COMPUTER OPERATIONS AND HARDWARE 3502
Includes computer graphics and data processing.
For components see *33 Electronics and Electrical Engineering.*

61 COMPUTER PROGRAMMING AND SOFTWARE 3503
Includes computer programs, routines, and algorithms.

62 COMPUTER SYSTEMS 3508
Includes computer networks.

63 CYBERNETICS 3508
Includes feedback and control theory.
For related information see also *54 Man/System Technology and Life Support.*

64 NUMERICAL ANALYSIS 3510
Includes iteration, difference equations, and numerical approximation.

65 STATISTICS AND PROBABILITY 3514
Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

66 SYSTEMS ANALYSIS 3515
Includes mathematical modeling; network analysis; and operations research.

67 THEORETICAL MATHEMATICS 3516
Includes topology and number theory.

PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.
For related information see also *Engineering.*

70 PHYSICS (GENERAL) 3517
For geophysics see *46 Geophysics.* For astrophysics see *90 Astrophysics.* For solar physics see *92 Solar Physics.*

71 ACOUSTICS 3517
Includes sound generation, transmission, and attenuation.
For noise pollution see *45 Environment Pollution.*

72 ATOMIC AND MOLECULAR PHYSICS 3519
Includes atomic structure and molecular spectra.

73 NUCLEAR AND HIGH-ENERGY PHYSICS 3520
Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

74 OPTICS 3521
Includes light phenomena.

75 PLASMA PHYSICS 3523
Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

76 SOLID-STATE PHYSICS 3524
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS 3528
Includes quantum mechanics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) 3529
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 3535
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 3535
Includes information storage and retrieval technology; micrography; and library science.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS N.A.
Includes cost effectiveness studies.

84 LAW AND POLITICAL SCIENCE 3536
Includes space law; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 3537
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 3538
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS 3540
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION 3541
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance.* For space stations see *15 Launch Vehicles and Space Vehicles.*

92 SOLAR PHYSICS 3542
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION 3542
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

99 GENERAL 3548

Note: N.A. means that no abstracts were assigned to this category for this issue.

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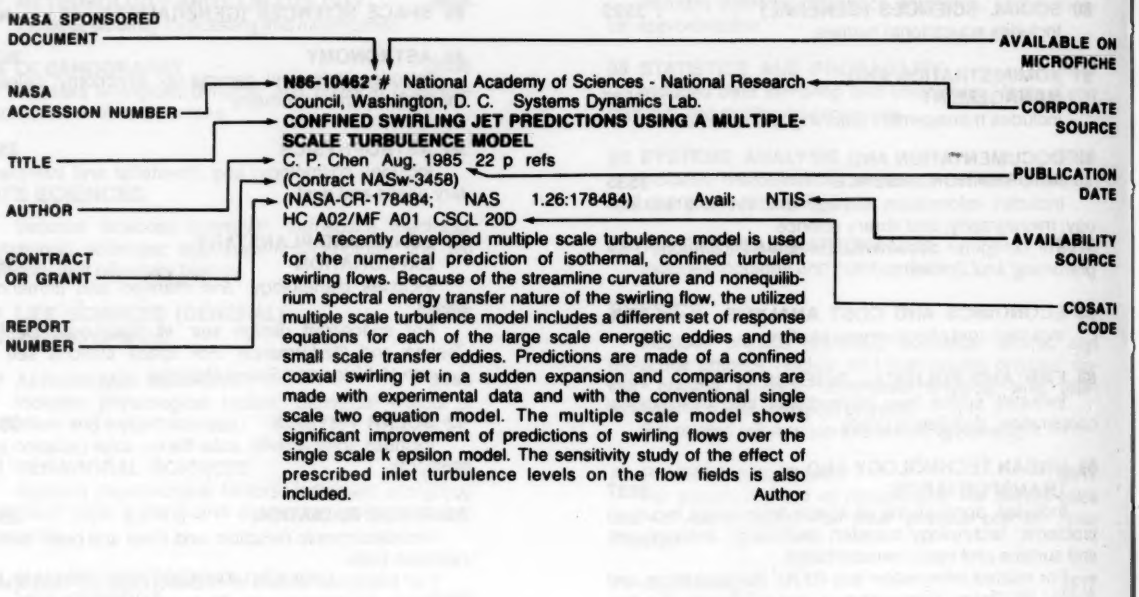
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REPORT NUMBER
N86-10462*# National Academy of Sciences - National Research Council, Washington, D. C. Systems Dynamics Lab.
CONFINED SWIRLING JET PREDICTIONS USING A MULTIPLE-SCALE TURBULENCE MODEL
C. P. Chen Aug. 1985 22 p refs
(Contract NASw-3458)
(NASA-CR-178484; NAS 1.26:178484) Avail: NTIS
HC A02/MF A01 CSCL 20D
A recently developed multiple scale turbulence model is used for the numerical prediction of isothermal, confined turbulent swirling flows. Because of the streamline curvature and nonequilibrium spectral energy transfer nature of the swirling flow, the utilized multiple scale turbulence model includes a different set of response equations for each of the large scale energetic eddies and the small scale transfer eddies. Predictions are made of a confined coaxial swirling jet in a sudden expansion and comparisons are made with experimental data and with the conventional single scale two equation model. The multiple scale model shows significant improvement of predictions of swirling flows over the single scale k epsilon model. The sensitivity study of the effect of prescribed inlet turbulence levels on the flow fields is also included.
Author

VOLUME 24 NUMBER 22 / NOVEMBER 23, 1986

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N86-30627# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Bonn (West Germany).
THE SECOND INTERNATIONAL SYMPOSIUM ON AEROELASTICITY AND STRUCTURAL DYNAMICS
1985 713 p Symposium held in Aachen, West Germany, 1-3 Apr. 1985; sponsored in cooperation with DFVLR, NLR and ONERA (DGLR-85-02; ISBN-3-922010-28-8; ESA-86-97411) Avail: NTIS HC A99/MF E03

Unsteady aerodynamics and aeroelastic characteristics; active control technology; structural modeling and optimization; structural system identification; and structural dynamics design verification of space structures were discussed. For individual titles, see N86-30628 through N86-30689.

N86-30628# Arizona State Univ., Tempe. Dept. of Mechanical and Aerospace Engineering.
TRANSONIC EQUIVALENT STRIP METHOD FOR AEROELASTIC APPLICATIONS c02
D. D. Liu, Y. F. Kao, and K. Y. Fung (Arizona Univ., Tucson) *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 17-32 Sponsored by DTNSRDC/NAVAIR (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

For unsteady flow computations of arbitrary wing planforms including control surfaces, a method based on the transonic equivalent strip (TES) model is developed. It consists of two consecutive correction steps to a given unsteady two-dimensional code. The latter can be a time-linearized transonic code or a nonlinear one such as LTRAN2 code. The mean-flow correction step involves an equivalent airfoil design procedure; the spanwise phase correction step accounts for the effects of acoustic wave propagation in three dimensions. Computed results using the TES method are compared with those obtained by methods such as versions of XTRAN3 code, Isogai's full potential code, and measured data. Computed cases include the Northrop F-5 wing in pitching oscillation, the AGARD standard RAE wing with an oscillating flap, and the LANN wing in pitching oscillation. ESA

N86-30629# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Aeroelastik.
CALCULATION OF THREE-DIMENSIONAL TRANSONIC POTENTIAL FLOWS BY A FIELD PANEL METHOD c02
R. Voss *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 33-46 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

A calculation method for three dimensional transonic flows around oscillating wings is described. It solves the time-linearized unsteady transonic small perturbation equation by an integral equation method with a field panel technique. In a computer code called PTRAN3, the field panel technique is combined with a finite difference method. Accuracy and computer costs of the code are acceptable for routine flutter applications. Results for applications to pitching motions of a rectangular wing and two swept wings (LANN wing and F5 wing) with high and low aspect ratio are shown. ESA

N86-30630# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
APPLICATION OF TRANSONIC UNSTEADY METHODS FOR CALCULATION OF FLUTTER AIRLOADS c08
H. Zimmermann and S. Vogel *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 47-61 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

The supercritical MBB-A3 profile was used as an example for calculating steady and unsteady pressure distribution by unsteady transonic codes. Most of the calculations were performed using the nonlinear TSP-equation and its time linearized form solved by a time marching method and by an integral method. The influence of the coefficient of the nonlinear term, of the inclusion of the steady or quasi-steady boundary layer thickness, and of the fulfillment of the Rankine-Hugoniot condition on the resulting pressure distribution is shown. Flutter calculations were made for a two degree of freedom representative section. The resulting critical speeds show a considerable variation depending on which method was used. Results show that there are good arguments for using time-linearized TSP methods in flutter calculations in the transonic domain. ESA

N86-30631# Fairchild Republic Div., Farmingdale, N. Y.
EXACT CLOSED-FORM SOLUTIONS FOR NONLINEAR UNSTEADY TRANSONIC AERODYNAMICS c02
Gabriel A. Oyibo *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 71-78 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

The existence of exact closed-form solutions for nonlinear unsteady aerodynamics is established. The full nonlinear unsteady velocity potential equations for an airfoil are considered. Evidence indicating why the traditional hodograph approach is ineffective for solving these equations is provided. A mapping scheme transforms these full nonlinear equations into the hodograph plane. Examination of the resulting hodograph equations reveals that by prescribing the Jacobian of the transformation, ab initio, the exact closed-form solutions can be obtained for the nonlinear unsteady aerodynamic characteristics of an airfoil in a potential flow. The shockless transonic results for inviscid analysis show trends that agree with previous data. Dips are observed in the pressure distributions as the free stream Mach number is varied. There are finite optimum reduced frequencies (Strouhal numbers) for the pressure distributions. This suggests a solution to the transonic dip problem associated with aeroelastic stability characteristics at transonic Mach numbers. ESA

N86-30632# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. of Aeroelasticity.

STEADY AND UNSTEADY PRESSURE DISTRIBUTION ON VARIOUS PROFILES IN SEPARATED SUBSONIC AND TRANSONIC FLOW **c02**

H. Triebstein *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 99-119 (For primary document see N86-30627 22-01)

Avail: NTIS HC A99/MF E03

Steady, mean, and unsteady aerodynamic data were measured on two dimensional rectangular wings, one with a supercritical MBB-Va2 profile and one with a NACA 0012 in subsonic flow and another supercritical MBB-A3 profile in transonic flow. The measurements were performed to produce systematic results with respect to Mach number, reduced frequency, incidence (wing, spoiler, tab) and amplitude of oscillation, and for use in the development and assessment of subsonic and transonic codes. The higher harmonic parts of the unsteady pressure in the region of pressure jumps and flow separation are emphasized. The wind tunnels, test setups, wing configurations, electronic data recording and processing devices, and the measuring procedure are described. ESA

N86-30633# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).

AN IMPROVED POTENTIAL GRADIENT METHOD FOR THE CALCULATION OF UNSTEADY AERODYNAMIC PRESSURES ON OSCILLATING WINGS IN SUPERSONIC FLOW **c02**

F.-Q. Zhang and H. Foersching *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 153-162 (For primary document see N86-30627 22-01)

Avail: NTIS HC A99/MF E03

A method to calculate pressure distributions on harmonically oscillating wings is presented. The method uses an integral variable substitution, by which the computer time is reduced considerably together with an improvement of computation accuracy, especially for low supersonic Mach numbers and high reduced frequencies. Comparisons with other methods and experimental results show quite satisfactory agreement. ESA

N86-30634# Tel-Aviv Univ. (Israel). Dept. of Solid Mechanics, Materials and Structures.

AN EXACT FORMULATION OF THE UNSTEADY AERODYNAMIC THEORY OF LIFTING SURFACES UNDERGOING ARBITRARY SMALL MOTIONS IN A SUPERSONIC FLOW FIELD **c02**

Liviu Librescu *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 163-168 (For primary document see N86-30627 22-01)

Avail: NTIS HC A99/MF E03

The indirect theory of unsteady lifting surfaces is developed. The integral equation (IE) relating a known downwash distribution to an unknown pressure distribution is derived without any restriction on the time dependence of field variables. The IE for simple harmonic motions and arbitrary small motions starting from rest at a certain time are obtained. In the latter case, the theory of generalized functions is used to derive the appropriate integral equation, by incorporating the associated initial conditions, and by highlighting properties of the aerodynamic kernel such as causality. The relationship between the aerodynamic kernels in the time and frequency domains is established. The problem analyzed is useful in the evaluation of the structural response of flight vehicles as well as in the active control problem of aeroelastic response. ESA

N86-30635# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Aeroelasticity.

THEORETICAL FLUTTER INVESTIGATIONS ON A PLANE CASCADE IN INCOMPRESSIBLE FLOW **c08**

V. Carstens *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 169-179 (For primary document see N86-30627 22-01)

Avail: NTIS HC A99/MF E03

An analysis which predicts the aeroelastic behavior of a plane cascade in incompressible flow is presented. The unsteady aerodynamic forces and moments acting on the blades are calculated by the method of surface layers. In the general case of bending and/or torsional modes, this method is based on the simultaneous solution of two linear integral equations of the second kind which contain the interaction of steady and unsteady blade loading as well as the influence of all other specific cascade parameters. The solution of the flutter equations for a two degree of freedom model is discussed on the basis of a given cascade configuration. ESA

N86-30636# Technische Univ., Brunswick (West Germany). Inst. fuer Stroemungsmechanik.

APPLICATION OF UNSTEADY WING COLLOCATION METHODS TO CASCADES IN SUBSONIC FLOW **c02**

A. Klose and B. Laschka *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 180-186 (For primary document see N86-30627 22-01)

Avail: NTIS HC A99/MF E03

A method to calculate the pressure distribution and unsteady forces on the blades of a flat plate cascade in subsonic flow during harmonic oscillation is presented. A collocation method as used in lifting surface theories for single airfoils was adapted to solve the cascade equation. Pressure distribution and aerodynamic forces for several values of stagger, reduced frequency, space-to-chord ratio, Mach number and interblade phase angle were calculated. The results were compared to published data. Significant differences are discovered. ESA

N86-30637# Northwestern Polytechnical Univ., Xian (China).

A NUMERICAL ANALYSIS FOR VERTICAL GUST FIELD INDUCED BY GUST GENERATOR **c08**

Yongnian Yang and Jianpei Wang *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 187-193 (For primary document see N86-30627 22-01)

Avail: NTIS HC A99/MF E03

A method for calculating vertical gust field induced by a gust generator, which consists of a group of oscillating vanes, based on subsonic unsteady lifting surface theory is presented. When the geometry of the gust generator, oscillating frequency and amplitude, and Mach number are given, the unsteady downwash field can be determined. In the calculation, the interference among the vanes is considered. Through numerical calculation, the characteristics of the vertical gust field induced by one, two, or three vanes with various reduced frequencies and Mach numbers are investigated. The influence of the gust generator on the characteristics of the vertical gust field are discussed, and conclusions for gust wind tunnel design are outlined. ESA

N86-30638*# California Univ., Berkeley. Dept. of Mechanical, Aerospace and Nuclear Enginee Ring.

A NEW LOOK AT ARBITRARY MOTION UNSTEADY AERODYNAMICS AND ITS APPLICATION TO ROTARY-WING AEROELASTICITY **c02**

Peretz P. Friedmann *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 194-210 (For primary document see N86-30627 22-01)

(Grant NAG2-209)

Avail: NTIS HC A99/MF E03 CSCL 01B

Research on arbitrary motion unsteady aerodynamics, emphasizing applications to rotary wing aeroelastic problems, is reviewed. Generalization of Greenberg's theory and its application to hingeless rotor aeroelastic stability; a technique for formulating finite state approximations to unsteady aerodynamic theories, suitable for fixed and rotary-wing applications, and its application to generalize Loewy's theory; comparison of fixed wing and rotary wing indicial response functions; influence of arbitrary motion aerodynamics, as represented by dynamic inflow on a helicopter in ground resonance; and comparison of dynamic inflow with arbitrary motion unsteady airfoil aerodynamics are covered. ESA

N86-30639# Shenyang Aircraft Corp. (China).
EXPERIMENTAL TRANSONIC PRESSURE DISTRIBUTIONS OF A FLEXIBLE WING-AILERON MODEL AND COMPARISONS WITH RESULTS OF SEVERAL THEORETICAL METHODS c02
De Guan, Weixing Liu, Zhiquan Gao, and Yuxin Zhang *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 211-218 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Analytical methods for the prediction of transonic load distribution due to large aileron deflection angle on a flexible wing were investigated. A 60 deg delta wing model with representative stiffness level and deflected aileron was tested in a high speed wind tunnel, and pressure distributions were measured. Second order transonic-small disturbance theory, linearized aerodynamic theory, and an empirical method based on rigid model pressure distributions were used to calculate the load distribution. The empirical method seems more powerful. ESA

N86-30640# Northwestern Polytechnical Univ., Xian (China).
CALCULATION OF THE LOAD DISTRIBUTION, AERODYNAMIC DERIVATIVES AND DYNAMIC CHARACTERISTICS OF QUASI-STATIC ELASTIC AIRCRAFT c02
Qiangang Liu, Changlin Wu, Zheng Jian, and Kai Wu *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 219-228 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

A numerical method for predicting the aerodynamic characteristics of quasi-static elastic aircraft is presented. The method can be used to evaluate the load distribution, control surface efficiency, aerodynamic derivatives and dynamic properties at subsonic speed. The aerodynamic calculations are based on the Green's function method. In structure deformation calculations, the free-structure influence coefficient method is used to evaluate the deformation of the elastic aircraft in free flight. The calculations are carried out for a large elastic aircraft. Results on load distribution, elevator efficiency, longitudinal aerodynamic derivatives, frequency responses to elevator input, and other dynamic properties are compared with those of the same aircraft where the elastic effect is not considered. ESA

N86-30641# Israel Aircraft Industries Ltd., Ben-Gurion Airport.
STATIC AEROELASTIC ANALYSIS USING AIRCRAFT VIBRATION MODES c39
Z. Sheena and M. Karpel *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 229-232 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

A method for the calculation of the airload distribution and aeroelastic effectiveness parameters of a flexible aircraft from the distribution of a rigid one, using its vibration modes, is presented. The method uses modal data of the model in the form of a limited number of low frequency mode shapes and their associated generalized stiffnesses. The mathematical operations are done on the generalized matrices of the model which have a small number of degrees of freedom. The method can calculate the static aeroelastic properties of a free-free aircraft using its elastic, inertial, and aerodynamic properties. The method is suitable for making parametric analyses involving changes in the stiffness of the structure and the aerodynamics of the model. Numerical examples are given and the convergence with the number of modes taken into account is discussed. ESA

N86-30642# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
A REVIEW OF AEROELASTIC RESEARCH AT THE FLIGHT DYNAMICS LABORATORY c08
T. M. Harris, T. E. Noll, T. J. Hertz, and W. A. Sotomayer *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 233-243 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Research on aeroservoelasticity, adaptive flutter suppression, the effects of stores carriage on body freedom flutter, and three dimensional transonic unsteady aerodynamics is discussed. Aeroservoelasticity studies involve research to develop tools for aeroelastic analyses of aircraft when active feedback control systems are taken into account. Adaptive flutter suppression for aircraft carrying external stores is evaluated by wind tunnel tests. Subsonic wind tunnel tests were performed to evaluate the effect of store location, mass, and inertia on aeroelastic stability. ESA

N86-30643# Fairchild Republic Div., Farmingdale, N. Y.
AEROELASTIC WIND TUNNEL SIMILARITY THEORY FOR ANISOTROPIC AIRCRAFT WINGS c08
Gabriel A. Oyibo *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 257-264 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

A theory outlining a simplified approach for aeroelastically simulating anisotropic aircraft wings is presented. An examination of the fundamental aeroelastic equations of motion for anisotropic aircraft wings, with the help of affine transformations, reveals that a unified simulation theory, which reduces to the existing theory in the isotropic limit can be formulated. It is discovered that the necessary condition for preserving the Strouhal number (reduced frequency) between the real aircraft wing and its wind tunnel model is by preserving the generalized forms of the similarity parameters suggested by Theodorsen and Garrick as well as new parameters. The additional similarity parameters reflect directional and coupling stiffness properties of anisotropic materials in a given aerospace structure. The results reduce to those for aircraft wings fabricated of isotropic materials if these new parameters are set equal to zero. ESA

N86-30644# British Aerospace Dynamics Group, Hatfield (England). Civil Div.
THE CHOICE OF TECHNIQUES USED FOR FLIGHT FLUTTER CLEARANCE WITH PARTICULAR REFERENCE TO THE BAe 146 AND BAe 125 c08
A. G. Woods *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 265-275 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

The considerations necessary to arrive at a safe and cost effective method of flutter clearance are discussed. Flight flutter tests of the BAe 146 and BAe 125, for both of which a fast sweep technique was chosed, are described. Methods of excitation, recording, and analysis are given. ESA

N86-30645# Saab-Scania, Linkoping (Sweden).
FLUTTER CALCULATION BY A NEW PROGRAM c08
Valter J. E. Stark *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 276-285 Sponsored by Swedish Defence Administration and Saab Scania A.B. (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

A flutter and response program based on general equations of motion is described. The equations are solved by Laplace transformation and by reducing the inversion integral to a sum of the residues at the poles at the zeros of the determinant. The resulting nonlinear eingenvalue problem, i.e., the problem of finding the zeros, is solved by the Newton-Raphson formula with numerical methods for calculation of the determinant and the principle of the argument for finding initial approximations. The program permits choice of different kinds of analytic functions in the linear approximation that is employed for approximating the aerodynamic transfer functions. Equations representing control laws of a flutter suppression system can be included. ESA

N86-30646# Pilatus Aircraft Ltd., Stans (Switzerland).
EXPERIENCE WITH AEROELASTIC ANALYSIS OF A SINGLE ENGINE TURBO TRAINER USING FINITE ELEMENT METHODS c39
M. J. Reinicke, A. S. Turi (Omega G.m.b.H., Immenstaad West

Germany), and A. Vollan *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 286-296 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

The PC-9 trainer aircraft dynamic analysis concept, based on a theoretical approach relying upon results of extensive ground vibration tests conducted on the similar structure of the PC-7, is outlined. The mathematical model shows good agreement with test results. Flight flutter tests verify the calculated aeroelastic stability. The program dealing with modal variation of mass, stiffness and damping allows changes on superelement level. Hence, the size of the residual structure can be further reduced and the CPU time cut down accordingly. ESA

N86-30647# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DEVELOPMENT OF A FLUTTER SUPPRESSION CONTROL LAW BY USE OF LINEAR QUADRATIC GAUSSIAN AND CONSTRAINED OPTIMIZATION DESIGN TECHNIQUES c08
William M. Adams and Sherwood H. Tiffany *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 297-308 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03 CSCL 01B

A control law to suppress symmetric flutter for a mathematical model of an aeroelastic research vehicle is developed. An implementable control law is attained by including modified linear quadratic Gaussian design techniques, controller order reduction, and gain scheduling. A complementary design approach for a flight condition wherein nongradient-based constrained optimization techniques are applied to maximize controller robustness is illustrated. ESA

N86-30648# London Univ. (England). Dept. of Aeronautical Engineering.
FINITE STATE MODELLING OF AEROELASTIC SYSTEMS FOR ACTIVE CONTROL APPLICATIONS: A GENERAL THEORY c63
Ranjan Vepa *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 309-319 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

The theory of modeling aeroelastic systems by finite state models is discussed. The models are classified as autonomous finite state models, time varying system models, and differential delay system models. It is shown that control law synthesis for active control can be performed using the differential delay model, which does not contribute to any additional states and is valid for the closed and open loop cases. However, control law implementation requires that the states used for feedback be measured directly or estimated from measurements which are linear combinations of system states. Direct measurements of all feedback states is probably not practical so that sensor output data processing is required. Two alternatives are the statistical Kalman-Bucy filter with error dynamics governed by the statistics of the measurements noise, and a state estimator with error dynamics selected arbitrarily. ESA

N86-30649# National Aerospace Lab., Amsterdam (Netherlands). Dept. of Aeroelasticity.
NLR EXPERIENCE IN THE APPLICATION OF ACTIVE FLUTTER SUPPRESSION AND GUST LOAD ALLEVIATION, APPLIED TO A WIND TUNNEL MODEL c08
P. A. vanGelder *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 320-329 Sponsored by Netherlands Agency for Aerospace Programs and NLR (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Control laws for flutter suppression and gust load alleviation systems were developed and tested using an aeroelastic model in a subsonic wind tunnel with the capability to simulate discrete or random gusts. Flutter suppression up to the maximum wind tunnel speed (1.4 m/sec) is achieved, while the gust load alleviation system reduces the wing root bending moment by 25% at 0.9 m/sec for simulated gusts with a Dryden spectrum. ESA

N86-30650# Royal Aircraft Establishment, Farnborough (England).
THE DESIGN AND WIND TUNNEL DEMONSTRATION OF AN ACTIVE CONTROL SYSTEM FOR GUST LOAD ALLEVIATION AND FLUTTER SUPPRESSION c08
I. W. Kaynes, C. W. Skingle, and J. C. Copley *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 330-347 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Wind tunnel tests on a flexible model with an active control system are described. A flutter suppression control law was designed and tested. It is shown that flutter suppression is achieved in the presence of gusts. The mathematical model of the aircraft includes descriptions of the whole aircraft motion and the flexible aircraft deformations. Physically realistic modifications were made to the mathematical model to enhance the agreement between predictions and the measured loads and responses. Physical understanding of the active controls is facilitated by an interactive control system design package. The predicted and measured performance of the control laws are presented. ESA

N86-30651# Northwestern Polytechnical Univ., Xian (China).
CONTROL LAW SYNTHESIS FOR GUST LOAD ALLEVIATION USING LINEAR QUADRATIC GAUSSIAN THEORY c08
Jin Chang *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 362-367 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

A method of using linear quadratic Gaussian synthesis in the design of multiloop gust alleviation for a flexible aircraft is presented. To obtain an aeroelastic sytem with a finite-order state form matrix equation, the aerodynamic influence coefficients are approximated by a rational function of s. A technique to minimize the number of augmented states is presented. For all the coefficient matrices, a matrix least squares formula is established. The fitting accuracy of this methods is better than other methods. ESA

N86-30652*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
STIFFNESS CONTROL OF LARGE SPACE STRUCTURES c18
Jay-Chung Chen and James L. Fanson *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 368-373 Sponsored by NASA (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03 CSCL 01B

A method of using internal force producing dual element/actuators for vibration suppression of large space structures is proposed. The technique is applied to a vibrating string and to a low order system. Response feedback control for the vibrating string and selected modal control are used for achieving the modal damping. The actuators may be electrically powered and are suitable for structures with extremely low rigidity. ESA

N86-30653# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
ASPECTS OF ACTIVE ISOLATION AS APPLIED TO A SATELLITE STRUCTURE WITH SHAPE PRECISION PAYLOAD c18
W. Charon *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 374-380 (For primary document see N86-30627 22-01)
(Contract ESTEC-5326/83-NL-PB(SC))
Avail: NTIS HC A99/MF E03

Active vibration control of flexible spacecraft is discussed. The satellite structure is divided into two rigid modules: the shape precision payload and a vibrating equipment module containing the attitude sensors and the attitude actuators. The two modules are connected by six spring-force actuator devices considered together to determine the isolation control forces. These connections transmit the low-frequency attitude control to the precision payload but attenuate the higher-frequency disturbances whose

shape and magnitude are unknown to the isolation control system. ESA

N86-30654# Grumman Aerospace Corp., Bethpage, N.Y.
THE APPLICATION OF PRACTICAL OPTIMIZATION TECHNIQUES IN THE PRELIMINARY STRUCTURAL DESIGN OF A FORWARD-SWEPT WING c05
Edwin Lerner *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 381-392 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

The application of optimization technology in design studies that preceded the full development of the Grumman X-29, forward swept wing, demonstrator aircraft is outlined. Finite-element resizing methods were developed to satisfy optimality criteria for strength and divergence-velocity constraints. Application of the methods in an initial feasibility study of a variable sweep wing and in a more detailed, fixed wing design study are described. The usefulness of the methodology at various stages of design in demonstrated by tracing the process that led to the selection of an efficient cover-laminate configuration. ESA

N86-30655# Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.
STRUCTURAL OPTIMIZATION PROGRAMS AND METHODS c05
A. J. Morris *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 393-406 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Minimum weight design algorithms used in computer aided aircraft design are reviewed. Applications to carbon fiber composite wings, aircraft flaps, fuselages, and an automobile seat are illustrated. ESA

N86-30656# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
VARIATION OF ANISOTROPIC BEHAVIOR IN STRUCTURAL OPTIMIZATION c05
G. Hornung, D. W. Mathias, and H. Roehrle *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 407-414 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Use of the gradient method to optimize carbon fiber reinforced composite airframe design is described. The optimization process consists of two major parts. The first part of the calculation is done to select the fiber orientations for a given structure under a given load. In the second part this preoptimized configuration is improved by varying the thicknesses of the layers, leading to the optimum design. This design having preoptimized compounds is compared with a corresponding quasiisotropic structure and a design having four fixed fiber directions but different thicknesses of the layers. The preoptimized design is shown to be best adapted to the load bearing requirements of the structure. ESA

N86-30657# Purdue Univ., West Lafayette, Ind. School of Aeronautics and Astronautics.
TAILORING METHODOLOGY FOR AEROELASTIC STABILITY AND LATERAL CONTROL ENHANCEMENT c08
Terrance A. Weisshaar *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 415-425 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Uses of aeroelastic tailoring to enhance aircraft structural design for dynamic response are discussed. The incorporation of directional stiffness into a design may alter drastically the mode shapes and frequencies of lifting surface. This alteration affects dynamic aeroelastic interactions between modal forces as well as the modal forces themselves. Tailoring to increase flutter speed generally produces a degradation of the classical divergence speed. As a result, the freedom of the wing to move as a rigid body in concert with the fuselage may render the aircraft susceptible to an attitude instability called body-freedom flutter. Thus, aeroelastic tailoring may lead to aeroelastic behavior characteristics not unlike those of swept forward wings. Tailoring may improve controllability at reduced cost. It may provide increased effectiveness of active control by creating a harmonious control/structure environment. ESA

N86-30658# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
STRUCTURAL OPTIMIZATION WITH CONSTRAINTS IN DYNAMICS c18
Horst J. Baier *In* DGLR The 2nd International Symposium on Elasticity and Structural Dynamics 1985 p 426-433 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Application of mathematical programming for spacecraft optimum structural design, especially weight minimization under static constraints is discussed. Since optimization under dynamic response in general leads to highly nonconvex problems, special care has to be taken for considering local optima. Whatever solution strategy is applied, availability of derivatives of the response is highly desirable. The control force approach is an interesting alternative to the classical mathematical optimization approaches. Since it usually leads to linear problems it is very efficient and circumvents problems related with nonconvexity. Examples to outline the findings are given. ESA

N86-30659# Fairchild Republic Div., Farmingdale, N. Y.
ANISOTROPIC WING AEROELASTIC THEORIES WITH WARPING EFFECTS c02
Gabriel A. Oyibo and Julian H. Berman *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 434-440 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

The influence of warping (spanwise axial constraints on wing twist) on anisotropic wing aeroelastic oscillations is investigated using a similarity rule approach. Results show that a high aspect ratio anisotropic wing could behave aeroelastically like a low aspect ratio wing and vice-versa. Similarity parameters derived in the analysis expose conditions for which this might happen. The analysis also indicates that the parameter that is currently used in determining when warping is important (or when not to use the St Venant's torsion theory) is inaccurate for anisotropic wings. The correct parameter is presented. ESA

N86-30660# Tel-Aviv Univ. (Israel). Faculty of Engineering.
RECENT RESULTS ON THE WEIGHT MINIMIZATION OF PANELS WITH A FLUTTER SPEED CONSTRAINT c05
L. Librescu and L. Beiner *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 441-450 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Weight minimization of flat and curved panels exposed to a supersonic flow and subjected to a flutter speed constraint is described. The analysis encompasses axisymmetric circular cylindrical shells and rectangular orthotropic flat panels. Optimal control in a single variable and of distributed parameter systems is used in deriving the optimality equations. In order to ensure that the flutter speed of the optimal panel coincides with the constrained one, a flutter instability condition is employed. Galerkin's technique is used for solving the optimality equations and the influence of orthotropicity ratio, in-plane loads, aspect ratio, and boundary conditions on the optimal thickness distribution is determined. For the case of pure transverse shear panels, an aeroelastic paradox similar to the membrane paradox is revealed. The cases of 1-D type panels and isotropic 2-D panels are also considered. ESA

N86-30661# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. for Structural Mechanics.
EFFECTS OF ANISOTROPIC DESIGN ON THE STATIC AEROELASTICITY OF A SWEPT WING
Matthias Piening *In* DGLR The 2nd International Symposium on

Aeroelasticity and Structural Dynamics 1985 p 451-456 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

A simple structural idealization is adopted to model an arbitrary swept anisotropic wing of moderate to high aspect ratio. The related differential equations are solved for the deformations and internal forces by multiple shooting. The divergence speed is calculated by searching the lowest eingenvalue of the structural matrix formed from the transfer matrices of the wing sections and the according boundary conditions. Parametric evaluations are performed. ESA

N86-30662# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
AEROELASTIC PROBLEMS AND STRUCTURAL DESIGN OF A TAILLESS CARBON FIBER COMPOSITE (CFC) SAILPLANE **c05**
J. Schweiger, O. Sensburg, and H. J. Berns (Technische Univ., Brunswick, West Germany) *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 457-468 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Severe instability at low speed in a 1/3 scale model of a 15 m sailplane was studied. Flutter calculations using data from a ground resonance test show that coupling of the rigid body short period mode with the first elastic mode causes the phemomenon. The wing was redesigned with the optimization programs FASTOP and TSO to find optimum fiber orientations and stiffness distributions for aeroelastic and strength requirements. By applying these computer codes the flutter speed is increased to an acceptable level with small modifications of the wing root geometry, a new design of the main spar, and by using a high modulus fiber type. With a small weight penalty compared to the initial design the flutter speed can be doubled. ESA

N86-30663# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. of Aeroelasticity.
SIMULATION OF AIRCRAFT TAXI TESTING ON THE AGILE SHAKER TEST FACILITY **c09**
Raymond Freymann and William P. Johnson (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio) *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 468-476 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Use of the Aircraft Ground Induced Loads Excitation test facility, an array of three independent shakers which allows laboratory simulation of an aircraft taxiing on rough surfaces, in the dynamic qualification process and for verification of the mathematical structural model of an aircraft is described. Experimental determination of the elastomechanical characteristics of aircraft landing gears and tires is outlined. ESA

N86-30664# Liege Univ. (Belgium).
DYNAMIC ANALYSIS OF STRUCTURES WITH FLEXIBLE ROTORS **c07**
M. Geradin and N. Kill *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 477-485 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Analytical tools for the dynamic structural analysis of machines with rotating parts such as aircraft engines are described. The finite element analysis is used for discretization, and the rotating parts are described using a 3-D formalism which includes in the kinetic energy expression the gyroscopic effects induced by the local changes of angular velocity produced by the deformation. The implementation of the formalism is specialized to the modeling of flexible rotors made of shafts and disks typical of modern aircraft engines. The effectiveness of the component mode synthesis method to reduce the size of the system of equations is demonstrated in the case of systems made of rotating and fixed parts. Critical speed and stability analyses and unbalance response calculations are performed by a sweeping procedure. The concepts are applied to the dynamic analysis of a high by-pass ratio aircraft engine. ESA

N86-30665# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
STRUCTURAL DYNAMIC ASPECTS OF ROTOR NODAL ISOLATION **c05**
J. Stoppel *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 486-494 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

An Antiresonance Isolation System (ARIS) for helicopters is described. In the passive nodal isolation system, the antiresonant frequency is tuned to the main rotor passage frequency to prevent the transmission of the oscillatory hub forces and moments to the fuselage. Analysis demonstrates that the nodal rotor isolation system may be strongly influenced by the structural dynamics of the helicopter. Due to the numerous eingenvalues the antiresonant frequency of the isolation system may be compensated by an adjacent natural frequency. In this case the desired isolating effect disappears. The complexity of the three dimensional structure aggravates the understanding and prediction of vibration system. For the BK 117 helicopter with MBB-ARIS, the structural optimization is demonstrated using finite element methods. ESA

N86-30666# RESSULT, Soechtenau (West Germany).
ANALYTICAL FINITE ELEMENTS **c39**
Peter H. Kulla *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 495-503 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Continuous element techniques for analyzing linear dynamic systems are outlined, and their efficient use of computer power is described. Systems can be condensed without loss of accuracy. It is not necessary to choose the coordinates to be eliminated in such a way that the error introduced by static reduction schemes is minimized. This gives the freedom to eliminate systematically all inner coordinates of a (sub-) structure and to describe a system in the coordinates of the boundary points only. This feature is highly desirable if two or more structures are considered substructures and are assembled to a higher level system. For reasons of flexibility this procedure has to work repeatedly at different system levels. The approach is only feasible if every substructure (including the final one) is a selfcontained module. ESA

N86-30667# Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
INFLUENCE OF AXIAL FORCE ON RANDOM VIBRATION RESPONSE OF A STRUCTURE **c39**
Isaac Elishakoff *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 504-511 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Random vibration of a beam simply supported at its ends, including the effect of a deterministic axial loading is studied. The beam is excited by a random transverse load represented by a space and time wise ideal white noise. A closed-form solution is obtained for the displacement space-time correlation function at zero time lag. It is shown that as the axial load approaches the Euler buckling level, the random displacement response increases indefinitely. For axial loads below this level, the obtained expressions permit direct evaluation of probabilistic characteristics of the response. ESA

N86-30668# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
DETERMINATION OF BOTH COMPLEX CHARACTERISTIC STRUCTURAL VALUES AND NORMAL MODE PARAMETERS FROM HARMONIC EXCITATION NEAR RESONANCE **c39**
J. Artmann *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 512-522 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

A method of performing system identification on damped elastomechanical structures is proposed. It applies a complex transformation to the usual generalized dynamic equation of motion, giving the possibility to use arbitrary complex response modes to set up the equation of motion. Using harmonic excitation, such response modes can be produced easily and quickly in a conventional vibration test, because no adjustment to natural frequencies or force vectors is necessary. As a consequence of transforming the generalized equation of motion, complex structural system parameters are created, being the elements of two complex matrices which are neither diagonal nor symmetric. However, simple mathematical relations can be derived to compute the elements of these matrices. Any dynamic structural problem, e.g., the flutter problem, can be solved without further knowledge of the usual normal mode parameters. ESA

N86-30669# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. of Aeroelasticity.
ADVANCES IN GROUND VIBRATION TESTING USING A COMBINATION OF PHASE RESONANCE AND PHASE SEPARATION METHODS c39
N. Niedbal *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 523-528 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

A ground vibration test (GVT) method that uses the complex response modes obtained directly from harmonic excitation near resonance with the arbitrary force distribution to set up the generalized dynamic equation of motion without knowledge of normal modes and normal mode parameter was derived. The dominating quantities of the method are the response mode matrices and the characteristic matrices which may be compared with the generalized mass and stiffness matrices of the phase resonance method. It is demonstrated how to derive normal mode shapes and associated normal mode parameters from the information contained in the characteristic matrices and in the response mode matrices. The method was validated by applying it to the solution of a flutter problem and the evaluation of normal mode parameters. Data were obtained from a GVT performed on a full-scale aircraft. ESA

N86-30670# Franche-Comte Univ., Besancon (France). Lab. de Mecanique Appliquee.
SIMULTANEOUS DETERMINATION OF NORMAL EIGENMODES AND GENERALIZED DAMPING MATRIX FROM COMPLEX EIGENMODES c39
Qiang Zhang and Gerard Lallement *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 529-535 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

An iterative method that deals simultaneously with the eigensolutions of the associated conservative structure from identified complex eigensolutions, and the generalized damping matrix from the identified complex eigensolutions is outlined. It leads to an improved coherence of these two types of data. It proves to be relatively stable and little modified by the errors of generalized masses. The method is illustrated by numerical and experimental examples. ESA

N86-30671# Kassel Univ. (West Germany).
IDENTIFICATION AND DYNAMIC CONDENSATION OF PHYSICAL SYSTEM MATRICES USING INCOMPLETE DYNAMIC RESPONSE DATA c39
M. Link and K. Badenhausen *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 536-545 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Two direct identification methods, one in the frequency domain the other in the time domain, are presented. The concept of so-called incomplete system identification is introduced. The application of the two methods to a small scale hardware model is shown. ESA

N86-30672# Spar Aerospace Ltd., Toronto (Ontario).
MODAL PARAMETERS ESTIMATION FROM DRIVEN-BASE TESTS c18
S. Draisey, F. R. Vigneron (Department of Communications, Ottawa, Ontario), Y. Soucy, and J.-G. Beliveau (Sherbrooke Univ., Quebec) *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 546-552 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

The theory for a modal method of extraction of modal parameters from uniaxial driven base tests is outlined. With accelerometer data from the driven base and points on the structure, modal frequencies, damping factors, mode shapes, and the product of modal momentum times normalization constant can be determined. The results of a structure tested in driven base random and sine are presented. The structure tested represented a configuration typical of communications satellite in stowed configuration. The driven base results are compared with those obtained from a fixed base single point random survey. Comparison shows that the method is accurate and practical. ESA

N86-30673# London Univ. (England). Dept. of Aeronautical Engineering.
DETERMINATION OF FORCE DISTRIBUTIONS IN MULTI-POINT RESONANCE TESTING USING VARIOUS DIRECT METHODS c39
K. Alexiou and J. R. Wright *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 553-564 Sponsored by UK Ministry of Defence (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Direct methods, which use the measured receptance matrix between several measurement and force positions, are applied to simulated six degree of freedom data with two closely spaced modes. An alternative to Asher's (1958) method, based on an eigenvalue solution followed by an eigenvector interpolation, is shown to improve the determination of the number of effective modes (and hence exciters needed) and also of the required force distribution. A similar eigenvalue method based on the characteristic phase lag theory proposed by Traill-Nash (1958) is also studied and, apart from an apparent sensitivity to noise which needs further consideration, seems to be an improvement on both approaches to Asher's method. ESA

N86-30674# Franche-Comte Univ., Besancon (France). Lab. de Mecanique Appliquee.
EIGENSOLUTION IDENTIFICATION OF NON SELF-ADJOINT MECHANICAL STRUCTURES c39
Qiang Zhang and Lallement Gerard *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 565-570 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

An identification method of left hand side and right hand side eigenvectors for non self-adjoint structures which have to be modelled by nonsymmetric state matrices is proposed. The method is based on the results of modal identifications successively performed on the initial structure and the same structure with additional masses. It gives good results for two simple laboratory structures. ESA

N86-30675# Manchester Univ. (England). Simon Engineering Labs.
RECENT DEVELOPMENTS IN THE IDENTIFICATION OF NON-LINEARITY IN MODAL TESTING c39
G. R. Tomlinson *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 571-580 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

The optimum frequency response function, the bispectrum and Volterra series, and the Hilbert transform are reviewed. It is shown that the use of the optimum frequency response function produces a linearized function but this cannot be used directly to identify the nonlinearity, whereas with the Hilbert transform a direct

indication of nonlinearity is obtained. The bispectrum and Volterra series are discussed in relation to their applicability in modal testing. Details on the Hilbert transform and its application in modal testing is presented. ESA

N86-30676# Old Dominion Coll., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
ADVANCES IN TIME DOMAIN MODAL IDENTIFICATION AND MODELING OF STRUCTURES **c39**
Samir R. Ibrahim *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 581-594 Sponsored by AFWAL (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Modal identification frequency domain methods from the Kennedy and Pancu technique (1947) to existing transfer function methods is reviewed. Time domain methods are discussed. A time domain approach using an upper Hessenberg sparse matrix is presented and shown to reduce computational requirements and produce higher identification accuracy for damping factors. Future directions and hardware and software needs are summarized. ESA

N86-30677# London Univ. (England). Queen Mary Coll.
COMPARISON OF SOME TIME DOMAIN METHODS FOR STRUCTURAL SYSTEM IDENTIFICATION **c39**
J. E. Cooper and J. R. Wright *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 595-604 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Time domain parameter identification methods based on the difference equation model relating sampled response and excitation are considered. The least squares, instrumental variables, and correlation fit methods are described and applied to one and two mode simulated data in the presence of input or measurement noise with various noise-to-signal ratios. Test results are compared statistically to examine the scatter on damping results and whether they are biased. The correlation fit method is seen to be the most suitable for development. ESA

N86-30678# Northwestern Polytechnical Univ., Xian (China). Dept. of Aircraft Engineering.
DETERMINATION OF NATURAL VIBRATION PROPERTIES OF A WING WITH WINGLET BY EXPERIMENTAL MODE SYNTHESIS TECHNIQUE **c05**
S. N. Gu, W. J. You, and J. S. Jiang *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 605-611 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Nine lowest natural frequencies and their corresponding natural modes of a wing model with winglet were determined using electric measurement and laser time-averaged holographic interferometry supplemented by sand contours. Three-dimensional quantitative analysis and orthogonalization of the three lowest natural modes of wing with winglet are carried out. Modal synthesis is used to get lower ordered natural frequencies and modes of the wing model with winglet, by using the six lowest orthogonalized modes of the wing and three lowest orthogonalized modes of the winglet. Calculated results of natural frequencies and modes of the wing with winglet and its wing by finite element method agree quite well with experimental data. ESA

N86-30679# Israel Aircraft Industries Ltd., Ben-Gurion Airport.
RAPID VIBRATION MODE ANALYSIS OF AIRCRAFT WITH EXTERNAL STORES **c05**
M. Karpel *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 612-616 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

A method for coupling the vibration modes of a central structure to additional substructures is presented. A set of low frequency natural modes, including rigid body modes, represents the central structure. These modes are obtained by a mathematical model loaded with a set of fictitious masses at the connection to the substructures degrees of freedom. The substructures are represented by their mass properties, vibration modes with clamped boundary conditions and free-free rigid body modes. The connection of each substructure to the central structure is statically determinate. The method is applied for vibration analysis of aircraft with external stores. The coupled aircraft + stores dynamic properties may be efficiently used for flutter analysis. Comparison with vibration modes obtained by a direct (full-size) eigensolution shows very accurate coupling results with low order eigensolutions. ESA

N86-30680# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
ANALYSIS-TEST CORRELATION OF DYNAMIC MATHEMATICAL MODELS **c18**
B. Caesar *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 617-624 (For primary document see N86-30627 22-01)
(Contract ESTEC-5597/83/NL-PB(SC))
Avail: NTIS HC A99/MF E03

The reasons for correlation of test and analysis results as well as for the mathematical model update process are summarized and related to the total development flow of a spacecraft structure. Correlation methods such as modal scale factor, assurance criteria, and enhanced frequency response functions are reviewed. Berman's method symmetry, and orthogonality conditions with a least squares deviation of updated against previous mass and stiffness matrices is improved by taking into account rigid body masses. The algorithmic approaches are discussed leading to linear least squares problems under equality constraints. Applications of this method based on simulated test data and recommendations for improvements in related modal tests are given. ESA

N86-30681# Technische Univ., Hanover (West Germany).
UPDATING MATHEMATICAL MODELS ON THE BASIS OF VIBRATION AND MODAL TEST RESULTS, A REVIEW OF EXPERIENCE **c39**
H. G. Natke and N. Cottin *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 625-631 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

Structural model updating procedures based on the method of weighted least squares are reviewed. These use input and output, residuals, the equation error, and partial residuals for modal quantities. Results of simulated tests show the (statistical) properties of the applied least squares estimators. Real applications are presented. ESA

N86-30682*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TEST AND ANALYSIS CORRELATION FOR STRUCTURAL DYNAMIC SYSTEMS **c18**
Ben K. Wada and Jay-Chung Chen *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 632-647 Sponsored by NASA (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03 CSCL 01B

Activities in modifying a structural mathematical model to correlate with its modal test results are summarized. Results from the Viking and Galileo spacecraft, and developments in the parameter estimation of structural mathematical models of large flexible structures using multiple boundary condition tests are presented. ESA

N86-30683*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DYNAMIC VERIFICATION OF VERY LARGE SPACE STRUCTURES **c18**
Brantley Hanks, R. *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 648-655 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03 CSCL 01B

A research program in spacecraft structures, structural dynamics, and controls verification using a relatively large, flexible beam as a focus is introduced. This research effort addresses fundamental problems applicable to the verification of large, flexible space structures and combines ground tests, flight behavior prediction, and instrumented orbital tests. The program is expected to produce quantitative results for use in improving the validity of ground tests for verifying flight performance analyses. ESA

N86-30684# Technische Hochschule, Aachen (West Germany). Inst. fuer Leichtbau.

RECONSTRUCTION OF FORCING FUNCTIONS BASED ON MEASURED STRUCTURAL RESPONSES c18

H. Oery, H. Glaser, and D. Holzdeppe *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 656-668 Sponsored by Deutsche Forschungsgemeinschaft, ESA, and MBB/Erno G.m.b.H. (For primary document see N86-30627 22-01)

Avail: NTIS HC A99/MF E03

A structural analysis procedure to reconstruct the significant parts of the forcing function time-histories based on a restricted number of test records is presented. Use of the inverse application of the phase-plane method and Williams' method is proposed. The procedure is based on the fact that very slowly varying loads induce deformations, which can be determined using the stiffness matrix only. It can be applied to aerospace structures and to earthquake engineering. ESA

N86-30685# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

SPACECRAFT STRUCTURES DESIGN AND VERIFICATION c18

C. Stavrinidis *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 669-671 (For primary document see N86-30627 22-01)

Avail: NTIS HC A99/MF E03

Definition of spacecraft design loads, design and development of spacecraft structures, and qualification and acceptance of spacecraft structures are discussed. State of the art structural engineering; maturity of methodologies; sequence of events as they arise in spacecraft projects; trends; and future requirements are described. ESA

N86-30686# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).

LOW FREQUENCY DESIGN VERIFICATION OF LARGE SPACECRAFT STRUCTURES c18

E. Erben and K. Eckhardt *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 672-682 Sponsored by INTELSAT and ESTEC (For primary document see N86-30627 22-01)

Avail: NTIS HC A99/MF E03

Multiaxis vibration system (MAVIS) testing of large spacecraft structures is described. Specified acceleration time histories are compared with the realized time histories measured at base point of test item. For the uniaxial excitation compliance is very good. During two axis excitation the differences between specified and measured input time histories are significant. The deviations are associated with strong frequency and amplitude changes in the transient motion. However, these results are achieved with an open loop control configuration of test facility and improvements are possible. Simulations of antenna reactions suggest deviations between applied and specified forces but resulting acceleration responses on different structure points are comparable with results achieved in test with complete S/C (same order of maximum acceleration peaks). ESA

N86-30687# Department of Communications, Ottawa (Ontario). David Florida Lab.

VIBRATION QUALIFICATION AT THE DAVID FLORIDA LABORATORY c18

Rolf Mamen *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 683-688 (For primary document see N86-30627 22-01)

Avail: NTIS HC A99/MF E03

A facility for spacecraft integration and environmental tests to qualify flight hardware is presented. Its thermal vacuum, mass properties, radio frequency, and vibration testing services are used for programs ranging from black box level to complete spacecraft and space systems. Its comprehensive structural qualification capabilities were selected for the Remote Manipulator System, ANIK-D, Brazilsat, and L-Sat. ESA

N86-30688# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

INFLUENCE OF NONLINEAR SPACECRAFT COMPONENTS ON DYNAMIC LAUNCH AND IN-ORBIT RESPONSE c18

I. Kolsch and H. Baier *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 689-696 (For primary document see N86-30627 22-01)

Avail: NTIS HC A99/MF E03

Analytical and experimental investigations of a BAPTA-yoke-solar array system are presented. Harmonic balance, Fourier expansion, and perturbation methods were selected, since the system could be reasonably reduced to a springs-masses model with measured nonlinear force-displacement curves. The investigation shows significant dependency on maximum response frequencies and amplifications (pseudo damping) with (harmonic and random) input levels. Due to a shift in the point of operation in the nonlinear stiffness relation caused by quasistatic acceleration, the response data also significantly depend on the applied g-level, leading to considerable shifts in maximum response frequencies and loss of symmetries. For in-orbit dynamics with low static and dynamic input levels, maximum response frequencies could be relatively low. ESA

N86-30689# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

SIGNIFICANCE AND RELIABILITY OF DYNAMIC ANALYSIS METHODS DEMONSTRATED IN THE INSTRUMENT POINTING SYSTEM PROJECT c16

E. Hilbrandt and J. Kroeker *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 697-699 (For primary document see N86-30627 22-01)

Avail: NTIS HC A99/MF E03

The dynamic load analysis of the Instrument Pointing System to obtain design loads which can be used for detailed stress analysis and for the proof of safe life or fail safe design is summarized. Such design loads may be defined as a reduced load set enveloping the actual flight loads. The flight loads themselves are not used for stress analysis because of their great variety and because they are extremely dependent upon the design itself. It is the aim of the design loads to provide a flight load envelope which can remain unchanged throughout the entire course of the design process. As the transient load-contribution represents the greatest severity for the primary structure the determination of the design loads needs only to be demonstrated for the transient loads. ESA

N86-30690# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INTERNATIONAL AVIATION (SELECTED ARTICLES)

Tien Shey-Shi, Kuan-Ming Hsu, I-Tsai Kuo, and Chien Huang 14 Mar. 1986 35 p Transl. into ENGLISH from Guoji Hangkong (China), no. 2(264), Feb. 1985 p 24-26; 27-29; 45-46 (AD-A166748; FTD-ID(RS)T-0843-85) Avail: NTIS HC A03/MF A01 CSCL 01/3

Following are the partial contents of a report on international aviation: A few points on longitudinal jet ejection techniques; Foreign technology studies on external store separation; Stealth aircraft technology Current development and future prospects. GRA

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N86-30691*# New York Univ., New York. Courant Mathematics and Computing Lab.

THE METHOD OF COMPLEX CHARACTERISTICS FOR DESIGN OF TRANSONIC BLADE SECTIONS Research and Development Report

M. R. Bledsoe Jun. 1986 203 p

(Grant NAG2-345; Contract DE-AC02-76ER-03077; Grant NSF DMS-83-20430)

(NASA-CR-176978; NAS 1.26:176978; DOE/ER-03077/273) Avail: NTIS HC A10/MF A01 CSCL 01A

A variety of computational methods were developed to obtain shockless or near shockless flow past two-dimensional airfoils. The approach used was the method of complex characteristics, which determines smooth solutions to the transonic flow equations based on an input speed distribution. General results from fluid mechanics are presented. An account of the method of complex characteristics is given including a description of the particular spaces and coordinates, conformal transformations, and numerical procedures that are used. The operation of the computer program COMPRES is presented along with examples of blade sections designed with the code. A user manual is included with a glossary to provide additional information which may be helpful. The computer program in Fortran, including numerous comment cards is listed. B.G.

N86-30692*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.

AERODYNAMIC DRAG REDUCTION TESTS ON A BOX-SHAPED VEHICLE Final Report

Randall Lee Peterson and Doral R. Sandlin Aug. 1981 53 p

(Contract NCC4-1)

(NASA-CR-176982; NAS 1.26:176982) Avail: NTIS HC A04/MF A01 CSCL 01A

The intent of the present experiment is to define a near optimum value of drag coefficient for a high volume type of vehicle through the use of a boattail, on a vehicle already having rounded front corners and an underbody seal, or fairing. The results of these tests will constitute a baseline for later follow-on studies to evaluate candidate methods of obtaining afterbody drag coefficients approaching the boattail values, but without resorting to such impractical afterbody extensions. The current modifications to the box-shaped vehicle consisted of a full and truncated boattail in conjunction with the faired and sealed underbody. Drag results from these configurations are compared with corresponding wind tunnel results of a 1/10 scale model. Test velocities ranged up to 96.6 km/h (60 mph) and the corresponding Reynolds numbers ranged up to 1.3 x 10 to the 7th power based on the vehicles length which includes the boattail. A simple coast-down technique was used to define drag. Author

N86-30693*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.

AERODYNAMIC DATA BANKS FOR CLARK-Y, NACA 4-DIGIT AND NACA 16-SERIES AIRFOIL FAMILIES Final Report

K. D. Korkan, J. Camba, III, and P. M. Morris Jan. 1986 272 p

(Contract NAS3-272)

(NASa-CR-176883; NAS 1.26:176883) Avail: NTIS HC A12/MF A01 CSCL 01A

With the renewed interest in propellers as means of obtaining thrust and fuel efficiency in addition to the increased utilization of the computer, a significant amount of progress was made in the development of theoretical models to predict the performance of propeller systems. Inherent in the majority of the theoretical performance models to date is the need for airfoil data banks which provide lift, drag, and moment coefficient values as a function of Mach number, angle-of-attack, maximum thickness to chord ratio, and Reynolds number. Realizing the need for such data, a study was initiated to provide airfoil data banks for three commonly used airfoil families in propeller design and analysis. The families chosen consisted of the Clark-Y, NACA 16 series, and NACA 4 digit series airfoils. The various component of each computer code, the source of the data used to create the airfoil data bank, the limitations of each data bank, program listing, and a sample case with its associated input-output are described. Each airfoil data bank computer code was written to be used on the Amdahl Computer system, which is IBM compatible and uses Fortran. Author

N86-30694*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

COMPARISON OF EXPERIMENTAL SURFACE PRESSURES WITH THEORETICAL PREDICTIONS ON TWIN TWO-DIMENSIONAL CONVERGENT-DIVERGENT NOZZLES

John R. Carlson, Odis C. Pendergraft, Jr., and James R. Burley, II Aug. 1986 31 p Presented at the AIAA 4th Applied Aerodynamics Conference, San Diego, Calif., 9-11 Jun. 1986

(NASA-TM-87757; NAS 1.15:87757; AIAA-86-1803-CP) Avail: NTIS HC A03/MF A01 CSCL 01A

A three-dimensional subsonic aerodynamic panel code (VSAERO) was used to predict the effects of upper and lower external nozzle flap geometry on the external afterbody/nozzle pressure coefficient distributions and external nozzle drag of nonaxisymmetric convergent-divergent exhaust nozzles having parallel external sidewalls installed on a generic twin-engine high performance aircraft model. Nozzle static pressure coefficient distributions along the upper and lower surfaces near the model centerline and near the outer edges (corner) of the two surfaces were calculated, and nozzle drag was predicted using these surface pressure distributions. A comparison between the theoretical predictions and experimental wind tunnel data is made to evaluate the utility of the code in calculating the flow about these types of non-axisymmetric afterbody configurations. For free-stream Mach numbers of 0.60 and 0.90, the conditions where the flows were attached on the boattails yielded the best comparison between the theoretical predictions and the experimental data. For the Boattail terminal angles of greater than 15 deg., the experimental data for M = 0.60 and 0.90 indicated areas of separated flow, so the theoretical predictions failed to match the experimental data. Even though calculations of regions of separated flows are within the capabilities of the theoretical method, acceptable solutions were not obtained. Author

N86-30695*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

EXPERIMENTAL AND NUMERICAL RESULTS FOR A GENERIC AXISYMMETRIC SINGLE-ENGINE AFTERBODY WITH TAILS AT TRANSONIC SPEEDS

James R. Burley, II, John R. Carlson, and William P. Henderson Aug. 1986 20 p Presented at the AIAA 4th Applied Aerodynamics Conference, San Diego, Calif., 9-11 Jun. 1986

(NASA-TM-87755; NAS 1.15:87755; AIAA-86-1797-CP) Avail: NTIS HC A02/MF A01 CSCL 01A

Static pressure measurements were made on the afterbody, nozzle and tails of a generic single-engine axisymmetric fighter configuration. Data were recorded at Mach numbers of 0.6, 0.9, and 1.2. NPR was varied from 1.0 to 8.0 and angle of attack was varied from -3 deg. to 9 deg. Experimental data were compared with numerical results from two state-of-the-art computer codes. Author

N86-30696*# Colorado Univ., Boulder. Dept. of Aerospace Engineering Sciences.

NUMERICAL STUDIES OF POROUS AIRFOILS IN TRANSONIC FLOW Ph.D. Thesis. Final Report, 1 Jun. 1985 - 31 Aug. 1986

Chuen-Yen Chow 1986 114 p

(Contract NCC2-355)

(NASA-CR-179655; NAS 1.26:179655) Avail: NTIS HC A06/MF A01 CSCL 01A

A numerical tool is constructed to examine the effects of a porous surface on transonic airfoil performance and to help understand the flow structure of passive shockwave/boundary layer interactions. The porous region is located near the shock with a cavity underneath it. This study is composed of two parts. Solved in the first part, with an inviscid-flow approach, is the transonic full-potential equation associated with transpiration boundary conditions which are obtained from porosity modeling. The numerical results indicate that a porous airfoil has a wave drag lower than that of a solid airfoil. The observed lambda-shock structure in the wind-tunnel testing can be predicted. Furthermore, the lift could be increased with an appropriate porosity distribution. In the second part of this work, the modified version of either an interactive boundary layer (IBL) algorithm or a thin-layer Navier-Stokes (TLNS) algorithm is used to study the outer flow, while a stream-function formulation is used to model the inner flow in the shallow cavity. The coupling procedure at the porous surface is based on Darcy's law and the assumption of a constant total pressure in the cavity. In addition, a modified Baldwin-Lomax turbulence model is used to describe the transpired turbulent boundary layer in the TLNS approach, while the Cebeci turbulence model is used in the IBL approach. According to the present analysis, a porous surface can reduce the wave drag appreciably, but can also increase the viscous losses. As has been observed experimentally, the numerical results indicate that the total drag is reduced at higher Mach numbers and increased at lower Mach numbers when the angles of attack are small. Furthermore, the streamline pattern of passive shock/boundary layer interaction are revealed. Author

N86-30697*# Cornell Univ., Ithaca, N.Y. School of Mechanical and Aerospace Engineering.
AERODYNAMICS OF ENGINE-AIRFRAME INTERACTION Annual Progress Report, 1 Oct. 1985 - 30 Sep. 1986
D. A. Caughey 30 Aug. 1986 29 p
(Grant NAG2-373)
(NASA-CR-179657; NAS 1.26:179657) Avail: NTIS HC A03/MF A01 CSCL 01A

The report describes progress in research directed towards the efficient solution of the inviscid Euler and Reynolds-averaged Navier-Stokes equations for transonic flows through engine inlets, and past complete aircraft configurations, with emphasis on the flowfields in the vicinity of engine inlets. The research focusses upon the development of solution-adaptive grid procedures for these problems, and the development of multi-grid algorithms in conjunction with both, implicit and explicit time-stepping schemes for the solution of three-dimensional problems. The work includes further development of mesh systems suitable for inlet and wing-fuselage-inlet geometries using a variational approach. Work during this reporting period concentrated upon two-dimensional problems, and has been in two general areas: (1) the development of solution-adaptive procedures to cluster the grid cells in regions of high (truncation) error;and (2) the development of a multigrid scheme for solution of the two-dimensional Euler equations using a diagonalized alternating direction implicit (ADI) smoothing algorithm. M.G.

N86-30698*# Vigyan Research Associates, Inc., Hampton, Va.
PAN AIR APPLICATION TO THE F-106B
Farhad Ghaffari Aug. 1986 60 p
(Contract NAS1-17919)
(NASA-CR-178165; NAS 1.26:178165) Avail: NTIS HC A04/MF A01 CSCL 01A

The PAN AIR computer code was employed in the present study to investigate the aerodynamic effects of the various geometrical changes and flow conditions on a configuration similar to the F-106B half-airplane tested in the Langley 30x60-foot wind tunnel. The various geometries studied included two forebodies (original and shortened), two inlet flow conditions (open and closed) two vortex flap situations (off and on). The attached flow theoretical solutions were obtained for Mach number of 0.08 and angle of attack of 8 deg., 10 deg., 12 deg., and 14 deg. In general this investigation revealed that the shortening of the forebody or closing of the inlet produced only a small change in the overall aerodynamic coefficients of the basic F-106B configuration throughout the examined angles of attack. However, closing the inlet of the configuration resulted in a slightly higher drag level at low angles of attack. Furthermore, at and above 10 deg. angle of attack, it was shown that the presence of the vortex flap causes an increase in the total lift and drag. Also, these theoretical results showed the expected reduction in longitudinal stability level with addition of the vortex flap to the basic F-106B configuration. Author

N86-30699# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
PRESSURE TEST OF THREE ELLIPTIC MISSILE BODY CONFIGURATIONS Final Report, 15 - 17 Sep. 1985
Marvin E. Sellers (Calspan Field Services, Inc., Arnold AFS, Tenn.) Oct. 1985 39 p Prepared in cooperation with Calspan Corp., Arnold
(AD-A166552; AEDC-TSR-85-P19) Avail: NTIS HC A03/MF A01 CSCL 20/4

A wind tunnel test was conducted to obtain the surface pressure distributions of three elliptic missile body configurations. The test was performed at nominal Mach numbers from 0.4 to 1.3 at a constant nominal free-stream unit Reynolds number of 2.4 million per ft. The angle-of-attack range was -4 to 20 deg at sideslip angles of -4, 0, and 4 deg. Only sample tabulations of the test results are included in the report. GRA

N86-30700# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
AIR-ON DEMONSTRATION OF THE AEDC PWT TUNNEL 16T CAPTIVE TRAJECTORY SUPPORT SYSTEM Final Report, 21 Jul. - 26 Jul. 1985
Louisa L. Arendt (Calspan Field Services, Inc., Arnold AFS, Tenn.) Sep. 1985 68 p Prepared in cooperation with Calspan Field Service
(AD-A166888; AEDC-TSR-85-P17) Avail: NTIS HC A04/MF A01 CSCL 20/4

An air-on demonstration of the Captive Trajectory Support (CTS) system was conducted in the AEDC Propulsion Wind Tunnel (16T). The test objectives were: (1) to demonstrate the structural integrity of the CTS system; (2) to demonstrate the ability of the CTS system to satisfactorily obtain grid and trajectory generation data for a typical store model in free stream and relative to a simulated (flat plate) aircraft in a dynamic wind tunnel environment; (3) to obtain a Mach number calibration for the Tunnel 16T Cart 2 (Multipurpose Cart) with the CTS system installed. The 1/4-scale Maximum Volume Bomb (MVB) was used to represent a typical store. Data were obtained at free-stream numbers from 0.6 to 1.6 and at various compressor ratios. GRA

N86-30701# Dayton Univ., Ohio. Research Inst.
A SEMI-ANALYTICAL APPROACH TO THE INTEGRAL EQUATION (IN TERMS OF THE ACCELERATION POTENTIAL) FOR THE LINEARIZED SUBSONIC, OSCILLATORY FLOW OVER AN AIRFOIL Final Report, Mar. 1983 - Sep. 1985
Karl G. Guderley Mar. 1986 183 p
(Contract F33615-83-K-3207)
(AD-A167313; UDR-TR-85-91; AFWAL-TR-85-3119) Avail: NTIS HC A09/MF A01 CSCL 20/4

The kernel of the integral equation which describes the oscillatory flow over an airfoil has severe singularities. The mathematical questions that arise here are usually circumvented by the use of physical concepts; one concentrates, for instance, the pressures into lines, or even points and evaluates the upwash field by means of the Biot Savart law. The upwash so expressed in terms of the parameters that describe the pressure field is then matched at selected control points with the upwash prescribed by the boundary conditions. One thus obtains a finite linear system of equations for the parameters describing the pressure distribution. The selection of control points contains an element of uncertainty, because the upwash field generated by a pressure distribution of the assumed character is highly singular. In the present approach the pressure distribution is again represented

by a finite number of parameters and one ultimately solves a linear system of equations. But for the pressure a much smoother representation is chosen (piece-wise linear continuous functions). The upwash is then computed directly from the integral equation. Matching between the upwash distribution due to the unknown pressure distribution and that given by the boundary conditions is carried out in the average over upwash areas. Such a procedure requires repeated integrations. GRA

N86-30628# Arizona State Univ., Tempe. Dept. of Mechanical and Aerospace Engineering.
TRANSONIC EQUIVALENT STRIP METHOD FOR AEROELASTIC APPLICATIONS
D. D. Liu, Y. F. Kao, and K. Y. Fung (Arizona Univ., Tucson) *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 17-32 Sponsored by DTNSRDC/NAVAIR (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30629# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Aeroelastik.
CALCULATION OF THREE-DIMENSIONAL TRANSONIC POTENTIAL FLOWS BY A FIELD PANEL METHOD
R. Voss *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 33-46 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30631# Fairchild Republic Div., Farmingdale, N. Y.
EXACT CLOSED-FORM SOLUTIONS FOR NONLINEAR UNSTEADY TRANSONIC AERODYNAMICS
Gabriel A. Oyibo *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 71-78 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30632# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. of Aeroelasticity.
STEADY AND UNSTEADY PRESSURE DISTRIBUTION ON VARIOUS PROFILES IN SEPARATED SUBSONIC AND TRANSONIC FLOW
H. Triebstein *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 99-119 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30633# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
AN IMPROVED POTENTIAL GRADIENT METHOD FOR THE CALCULATION OF UNSTEADY AERODYNAMIC PRESSURES ON OSCILLATING WINGS IN SUPERSONIC FLOW
F.-Q. Zhang and H. Foersching *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 153-162 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30634# Tel-Aviv Univ. (Israel). Dept. of Solid Mechanics, Materials and Structures.
AN EXACT FORMULATION OF THE UNSTEADY AERODYNAMIC THEORY OF LIFTING SURFACES UNDERGOING ARBITRARY SMALL MOTIONS IN A SUPERSONIC FLOW FIELD
Liviu Librescu *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 163-168 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30636# Technische Univ., Brunswick (West Germany). Inst. fuer Stroemungsmechanik.
APPLICATION OF UNSTEADY WING COLLOCATION METHODS TO CASCADES IN SUBSONIC FLOW
A. Klose and B. Laschka *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 180-186 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30638*# California Univ., Berkeley. Dept. of Mechanical, Aerospace and Nuclear Enginee Ring.
A NEW LOOK AT ARBITRARY MOTION UNSTEADY AERODYNAMICS AND ITS APPLICATION TO ROTARY-WING AEROELASTICITY
Peretz P. Friedmann *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 194-210 (For primary document see N86-30627 22-01)
(Grant NAG2-209)
Avail: NTIS HC A99/MF E03 CSCL 01B

N86-30639# Shenyang Aircraft Corp. (China).
EXPERIMENTAL TRANSONIC PRESSURE DISTRIBUTIONS OF A FLEXIBLE WING-AILERON MODEL AND COMPARISONS WITH RESULTS OF SEVERAL THEORETICAL METHODS
De Guan, Weixing Liu, Zhiquan Gao, and Yuxin Zhang *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 211-218 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30640# Northwestern Polytechnical Univ., Xian (China).
CALCULATION OF THE LOAD DISTRIBUTION, AERODYNAMIC DERIVATIVES AND DYNAMIC CHARACTERISTICS OF QUASI-STATIC ELASTIC AIRCRAFT
Qiangang Liu, Changlin Wu, Zheng Jian, and Kai Wu *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 219-228 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30659# Fairchild Republic Div., Farmingdale, N. Y.
ANISOTROPIC WING AEROELASTIC THEORIES WITH WARPING EFFECTS
Gabriel A. Oyibo and Julian H. Berman *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 434-440 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N86-30702# Simula, Inc., Tempe, Ariz.
SEAT EXPERIMENT RESULTS OF FULL-SCALE TRANSPORT AIRCRAFT CONTROLLED IMPACT DEMONSTRATION Final Report, Jan. - Jul. 1985
Mark R. Cannon and Richard E. Zimmermann (RMS Technologies, Inc., Trevose, Pa.) Jul. 1986 248 p
(Contract DTFA03-81-C-00040)
(DOT/FAA/CT-85/25; TR-85413) Avail: NTIS HC A11/MF A01

The results of the Federal Aviation Administration (FAA) seat experiments tested in the joint FAA/NASA Controlled Impact Demonstration (CID) are described. Twenty-three seats were placed on the test aircraft. Thirteen seats were modifications of existing transport seats which were designed structurally to improve their crashworthiness. The remaining experiments were unmodified standard seats which included seven light and heavy-weight forward-facing seats, two aft-facing seats, and one flight attendant seat. Three additional seat experiments were placed onboard the test aircraft: two by NASA, and one by a private contractor. Onboard instrumentation was placed at specific locations to obtain data pertaining to airframe structural loads and seat/occupant response. Accelerometers were attached to the airframe and floor structure, the seat experiments, and the anthropomorphic dummies occupying the seats. The data base resulting from the test was intended for

validating crash prediction models and occupant/seat dynamic simulation models. Author

N86-30703# National Transportation Safety Board, Washington, D. C.
AIRCRAFT ACCIDENT REPORT: PROVINCETOWN, BOSTON AIRLINES FLIGHT 1039, EMBRAER BANDEIRANTE, EMB-110P1, N96PB, JACKSONVILLE, FLORIDA, DECEMBER 6, 1984
24 Jun. 1986 100 p
(PB86-910405; NTSB/AAR-86/04) Avail: NTIS HC A05/MF A01

Provincetown-Boston Airlines Flight 1039, an Embraer Bandeirante, was cleared from the Jacksonville International Airport, Jacksonville, Florida, to Tampa, Florida at 1805 eastern standard time on December 6, 1985, in visual flight conditions. There were 11 passengers and 2 crewmembers aboard the scheduled domestic passenger flight operating under 14 CFR 135. At 1812, flight 1039 was cleared for takeoff, and, at 1813, while over the departure end of the runway and climbing, the crew acknowledged a frequency change. Thirty seconds later, about 1814, the airplane was seen in a steep descent near the extended centerline of the runway. Flight 1039 struck the ground 7,800 feet beyond the departure end of runway 31 and 85 feet to the northeast (right) of the extended runway centerline in an inverted nose down attitude, after which it caught fire and burned. The airplane was demolished, and all 13 persons aboard were killed. Before ground impact, the horizontal stabilizer, including bulkhead No. 36, had separated from the fuselage. Both elevators and elevator tips, the tail cone assembly, and the aft portion of the ventral fin also had separated in flight. Author

N86-30704# Calspan Field Services, Inc., Arnold AFS, Tenn.
AIRCRAFT TRANSPARENCY TESTING: ARTIFICIAL BIRDS Final Report, 1 Jul. 1984 - 1 May 1985
C. J. Welsh and Vincent Centonze Apr. 1986 18 p Prepared in cooperation with AEDC
(AD-A166832; AEDC-TR-86-2) Avail: NTIS HC A02/MF A01 CSCL 14/2

An analysis was made concerning the use of artificial birds in bird impact testing of aircraft transparencies. Results of this analysis, including impact measurements at a nominal velocity of 500 fps, indicated that the use of artificial birds for impact testing at these conditions is impractical. This follows from the importance and difficulty of simulating the shear strength characteristics of real birds in transparency impacts. GRA

N86-30705# Weather Corp., Weston, Mass.
DEVELOPMENT OF AIRBORNE ELECTRIC FIELD AND LIGHTNING DETECTION INSTRUMENTATION FOR AVIATION SAFETY Final Report
Ralph Markson 20 Apr. 1986 30 p
(Contract N00014-85-C-0707)
(AD-A167342) Avail: NTIS HC A03/MF A01 CSCL 01/4

The objectives of Phase I were to investigate the use of simple corona current instrumentation on aircraft to measure thunderstorm electric fields and to conduct a feasibility study of a single station aircraft lightning interferometer to detect the occurrence and position of lightning. Both of these techniques have the common purpose of providing warning to aircraft crews when they are approaching potentially hazardous clouds and thunderstorms. The electric field measurement has the advantage of detecting electrified clouds which may not be producing lightning flashes but are nevertheless dangerous because an aircraft can trigger lightning; however this is a relatively short range system (on the order of 10 to 20 miles). The interferometer, which responds to RF pulses from lightning, has the advantage of long range detection (more than 100 miles) and can map the the position of lightning flashes in a manner similar to the way radar maps areas of rain. Thus the systems complement each other. GRA

N86-30706# Koninklijk Inst. voor de Marine, Den Helder (Netherlands).
THE BLACK BOX. SILENCE IS SILVER, SPEECH IS GOLDEN [DE ZWARTE DOOS. ZWIJGEN IS ZILVER, SPREKEN IS GOUD]
A. W. Pol Jul. 1984 151 p Partly in DUTCH and ENGLISH
(ESA-86-97394) Avail: NTIS HC A08/MF A01

Requirements, design and development, and feasibility aspects of Flight Data Recorders (FDR) and Cockpit Voice Recorders (CVR) are treated. Examples of existing systems (e.g., the U.S. Navy Universal Locator Airborne Data Systems, and the solid-state FDR) are given. Installation of FDR/CVR combined crash recorders in Westland Lynx helicopters is discussed. Aircraft accident relevant information, necessary adaptions of the helicopter, and feasibility were investigated. As the present aircraft indicating instruments often contain information after accidents it is concluded that installation of only a CVR is a feasible solution. However, future aircraft instruments (e.g., digital computers, and displays) might necessitate FDRs also. ESA

N86-30707# General Accounting Office, Washington, D. C. Resources Community and Economic Development Div.
AVIATION WEATHER HAZARDS: FAA (FEDERAL AVIATION ADMINISTRATION) SYSTEM FOR DISSEMINATING SEVERE WEATHER WARNINGS TO PILOTS Briefing Report
Apr. 1986 34 p
(PB86-195070; GAO/RCED-86-152BR; B-222882) Avail: NTIS HC A03/MF A01 CSCL 01B

Controllers at the nation's busiest airports sometimes do not have time to disseminate weather information to pilots. In addition, when weather information is given, it may not be given as soon as possible because controllers are too busy performing their primary duty of separating aircraft. FAA's procedure for communicating weather warnings by having controllers read them over their radio frequencies is too slow to avoid potential hazards, and some pilots may not receive any warning because of radio frequency changes. On-airport weather detection systems (LLWAS and ASR) do not provide controllers adequate detection or information about potentially hazardous weather because the radar cannot detect storm intensities, and the wind shear system cannot reliably detect the most dangerous form of wind shear, microbursts. GRA

N86-30708# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
INTERACTION BETWEEN EMP (ELECTROMAGNETIC PULSE), LIGHTNING AND STATIC ELECTRICITY WITH AIRCRAFT AND MISSILE AVIONICS SYSTEMS
1986 144 p Presented at a Lecture Series, Ankara, Turkey, 29-30 May 1986, Oberpfaffenhofen, West Germany, 2-3 Jun. 1986, and The Hague, The Netherlands, 5-6 Jun. 1986; sponsored by Avionics Panel and the Consultant and Exchange Programme of AGARD
(AGARD-LS-144; ISBN92-835-1528-5) Avail: NTIS HC A07/MF A01

Interactions between transient electromagnetic waves with aircraft and missile avionics systems are described. Transient electromagnetic waves include electromagnetic pulses (EMP) from nuclear explosions, lightning, and static electricity. Interactions are introduced by coupling of EMP and lightning induced currents and voltages with avionics components. Shielding against these interactions is discussed with respect to induced currents and voltages from EMP and lightning, and induced voltages from static charging effects. Several examples of interactions, coupling, shielding, and measurement techniques are presented. This Lecture Series, sponsored by the Avionics Panel of AGARD, has been implemented by the Consultant and Exchange Program of AGARD. Author

N86-30709# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
CRASHWORTHINESS OF AIRFRAMES
1986 34 p Presented at the 61st Meeting of the Structures and Materials Panel of AGARD in Oberammergau, West Germany, 8-13 Sep. 1985
(AGARD-R-737; ISBN92-835-1525-0) Avail: NTIS

HC A03/MF A01

At its 61st Meeting the AGARD Structures and Materials Panel heard three papers as a preliminary to setting up a Sub-Committee on this topic; this publication contains these papers. They survey a range of theoretical and experimental aspects of crashworthiness relating to metallic structures. For structures made of these materials theoretical methods are becoming useful design tools, but much further development is required before composite structures can be satisfactorily handled. There is a very great need for a data base of reliable experimental information (including accident data bases) on both metallic and composite structures. Author

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications.*

N86-30710*# Ohio Univ., Athens. Dept. of Electrical and Computer Engineering.

SPECIFICATION OF A NAVSTAR GLOBAL POSITIONING SYSTEM (GPS) RECEIVER FOR A DIFFERENTIAL GPS GROUND SYSTEM

Daryl L. McCall and Richard N. Turner Oct. 1984 18 p
(Grant NAG2-231)
(NASA-CR-177073; NAS 1.26:177073; TM-H-4) Avail: NTIS HC A02/MF A01 CSCL 17G

One step towards the successful completion of a functional ground unit for the Differential Global Positioning System (DGPS) will be in choosing a currently available GPS receiver that will accurately measure the propagation times of the satellite signals and have the capability to be electrically interfaced with and controlled by a Digital Equipment Corporation (DEC) PDP-11/34A computer. The minimum requirements and characteristics of a NAVSTAR Global Positioning System (GPS) receiver are described. The specific technical specifications addressed include data accuracies and resolutions, receiver interface/external control, enclosure dimensions and mounting requirements, receiver operation, and environmental specifications. M.G.

N86-30711# Radio Technical Commission for Aeronautics, Washington, D. C.

MINIMUM OPERATIONAL PERFORMANCE STANDARDS FOR AIRBORNE AREA NAVIGATION EQUIPMENT USING OMEGA/VLF INPUTS

May 1986 187 p Supersedes RTCA/DO-140
(RTCA/DO-190; RTCA/DO-140) Avail: NTIS HC A09/MF A01

Minimum operational performance standards for airborne area navigation equipment (2D and 3D) operated in the National Airspace System (NAS) using Omega/Very Low Frequency (VLF) signals are presented. Incorporated within these standards are equipment characteristics that should be useful to users, designers, manufacturers, and installers of the equipment. The performance functions and features are defined for a 2D system which performs both lateral and vertical guidance. Equipment may be manufactured and tested to meet 2D or 3D requirements (or both) in the in route mode. Author

N86-30712# Federal Aviation Agency, Atlantic City, N.J. Technical Center.

COMPREHENSIVE TEST AND EVALUATION OF THE DALMO VICTOR TCAS 2 INDUSTRY PROTOTYPES Final Report, Feb. 1986

Albert Rehmann Feb. 1986 245 p
(FAA/PM-862; FAA/CT-86/2) Avail: NTIS HC A11/MF A01

The test procedure and results of a five-part comprehensive evaluation of two prototype minimum Traffic Alert and Collision Avoidance System (TCAS) II units are described. The five parts include: (1) hardware and software verification, (2) cockpit display and operational procedure verification. (3) pilot and inflight observer training, (4) TCAS II demonstration to the aviation community, and (5) readiness for airworthiness certification testing. Overall, the minimum TCAS II prototype has matured into an acceptable test-bed for the 8-month inservice evaluation in a commercial airliner. System reliability has improved and pilot acceptance was generally good. It is expected that minimum TCAS II will provide a valuable service to airline pilots. Author

N86-30713# Defense Mapping Agency, Washington, D.C.

THE DMA/GPS EARTH ORIENTATION PREDICTION SERVICE Final Report

John A. Bangert 28 Apr. 1986 16 p
(AD-A166830) Avail: NTIS HC A02/MF A01 CSCL 08/5

Since mid-1984, the Defense Mapping Agency (DMA) has been computing predictions of pole position (x and y) and time difference (UT1-UTC = delta UT) to support the NAVSTAR/GPS orbit determination process. These predictions are based upon the derived Earth orientation parameters published in the U.S. Naval Observatory's Earth Orientation Bulletin (Series 7) and are obtained by fitting these data to a set of models specified in the DMA/GPS Interface Control Document. This paper presents a review of the models and processes by which the Earth orientation predictions are computed at DMA. The results of a study to assess the accuracy of these predictions are also presented. Finally, several proposed methods for improving the prediction accuracies without altering the basic models are discussed and evaluated. GRA

N86-30714# Computer Technology Associates, Inc., Englewood, Colo.

OPERATIONS CONCEPT FOR THE TCCC (TOWER CONTROL COMPUTER COMPLEX) MAN-MACHINE INTERFACE Final Report

H. L. Ammerman, E. S. Becker, L. J. Bergen, D. K. Davies, and E. E. Inman 28 Mar. 1986 771 p
(Contract DTFA01-85-Y-01034)
(AD-A166899; FAA/AP-86/02) Avail: NTIS HC A99/MF A02 CSCL 17/7

Operations Concept for the TCCC Man-Machine Interface analyzes the tower Air Traffic Controller's job in the Tower Control Computer Complex (TCCC) environment. It considers the operations in today's towers and the automated capabilities planned for the TCCC, to reach an understanding of the Controller's job after TCCC implementation. Three separate positions are analyzed: Local Control, Ground Control, and Clearance Delivery/Flight Data. Analysis results include composition graphs and narratives showing the logical flow through the sub-activities of the three positions; task analysis, presenting the tasks of each position; task characterizations, including information requirements, cognitive/sensory attributes, and performance criteria associated with each task; and a top-level dialogue description summarizing the interaction between controller and TCCC. Traceability between tasks and system level specification requirements is also provided. GRA

N86-30715# Federal Aviation Agency, Atlantic City, N.J.

HARDWARE PERFORMANCE ANALYSIS OF THE BASIC NARROW MICROWAVE LANDING SYSTEM (MLS) AT WASHINGTON NATIONAL AIRPORT (DCA) IN THE SERVICE TEST AND EVALUATION PROGRAM (STEP) Final Technical Note, 1 Jan. 1981 - 30 Jun. 1983

Marvin S. Plotka Sep. 1985 141 p
(AD-A166916; FAA/CT-TN85/19) Avail: NTIS HC A07/MF A01 CSCL 17/7

This is the final technical note for the Hardware Performance Analysis of the Basic Narrow Microwave Landing System (MLS) at Washington National Airport (DCA) in the Service Test and Evaluation Program (STEP) for the period January 1, 1981 through June 30, 1983. The MLS configuration, limits of signal operation, system and subsystem operation, data collection and analysis are

described. Equipment and environmental problem areas uncovered during the test and evaluation are discussed in the Results section of this report. Chargeable failures are identified and listed and engineering investigations are discussed. Remote Maintenance Monitoring System (RMMS) data analysis are presented. Conclusions and recommendations are listed. GRA

N86-30716# General Accounting Office, Washington, D. C. Resources Community and Economic Development Div.
AVIATION SAFETY: SERIOUS PROBLEMS CONCERNING THE AIR TRAFFIC CONTROL WORK FORCE
Mar. 1986 113 p
(PB86-194586; GAO/RCED-86-121; B-222217) Avail: NTIS HC A06/MF A01 CSCL 17G

The report entitled Aviation Safety: Serious Problems Concerning the Air Traffic Control Work Force contains the following: GAO statement on conditions within the air traffic control work force; Supplement to GAO statement on conditions within the air traffic control work force; GAO statement on conditions within air traffic control work force at six FAA facilities. GRA

N86-30717# National Weather Service, Fort Worth, Tex.
NATIONAL WEATHER SERVICE (NWS) SOUTHERN REGION QPF (QUANTITATIVE PRECIPITATION FORECASTING) WORKSHOP
Apr. 1986 98 p Workshop held in Houston, Tex., 3-5 Feb. 1986
(PB86-196201; NOAA-TM-NWS-SR-117) Avail: NTIS HC A05/MF A01 CSCL 17G

The National Weather Service (NWS) Southern Region QPF (Quantitative Precipitation Forecasting) Workshop 1986 held at Houston, Texas, on February 3 to 5, 1986 discussed the following: Synoptic climatology for heavy snowfall across Louisiana; The practical realities of QPF; An automated QPF verification program which provides both real-time and long-term statistical scores in a user-friendly environment; A closer look at the NGM QPF; Verification results for NMC 24-hour QPF; Operational satellite derived rainfall estimates with hurricanes Bob, Danny and Elena; Techniques at the National hurricane center for estimating maximum rainfall from tropical disturbances; and Synoptic climatology of heavy rainfall over South Florida, November to April. GRA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.*

N86-30718*# California Univ., Los Angeles. Dept. of Computer Science.
A.I.-BASED REAL-TIME SUPPORT FOR HIGH PERFORMANCE AIRCRAFT OPERATIONS Report, 15 May 1984 - 14 May 1985
Jacques Vidal, J. 1985 52 p
(Grant NAG2-302)
(NASA-CR-176906; NAS 1.26:176906) Avail: NTIS HC A04/MF A01 CSCL 01C

Artificial intelligence (AI) based software and hardware concepts are applied to the handling system malfunctions during flight tests. A representation of malfunction procedure logic using Boolean normal forms are presented. The representation facilitates the automation of malfunction procedures and provides easy testing for the embedded rules. It also forms a potential basis for a parallel implementation in logic hardware. The extraction of logic control rules, from dynamic simulation and their adaptive revision after partial failure are examined. It uses a simplified 2-dimensional aircraft model with a controller that adaptively extracts control rules for directional thrust that satisfies a navigational goal without exceeding pre-established position and velocity limits. Failure recovery (rule adjusting) is examined after partial actuator failure. While this experiment was performed with primitive aircraft and mission models, it illustrates an important paradigm and provided complexity extrapolations for the proposed extraction of expertise from simulation, as discussed. The use of relaxation and inexact reasoning in expert systems was also investigated. Author

N86-30719# Federal Aviation Administration, Washington, D.C.
ADVISORY CIRCULAR: AUXILIARY FUEL SYSTEM INSTALLATIONS
2 May 1986 53 p
(FAA/AC-25-8) Avail: NTIS HC A04/MF A01

The advisory circular (AC) provides guidance and criteria for the installation of auxillary fuel systems, i.e., those which supplement essential fuel systems to provide additional range, in transport category airplanes. It is intended primarily for installations in which the auxillary fuel is carried with the fuselage, such as within cargo or baggage compartments, the main deck or other similar areas. B.G.

N86-30720*# National Aeronautics and Space Administration, Washington, D.C.
NASA AND GENERAL AVIATION
Jeffrey L. Ethell 1986 140 p Original contains color illustrations
(NASA-SP-485; NAS 1.19:485) Avail: NTIS HC A07/MF A01 CSCL 01C

General aviation remains the single most misunderstood sector of aeronautics in the United States. A detailed look at how general aviation functions and how NASA helps keep it on the cutting edge of technology in airfoils, airframes, commuter travel, environmental concerns, engines, propellers, air traffic control, agricultural development, electronics, and safety is given. Author

N86-30721*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
IMPACT DATA FROM A TRANSPORT AIRCRAFT DURING A CONTROLLED IMPACT DEMONSTRATION
Edwin L. Fasanella (PRC Kentron, Inc., Hampton, Va.), Emilio Alfaro-Bou, and Robert J. Hayduk Sep. 1986 88 p
(NASA-TP-2589; L-16125; NAS 1.60:2589) Avail: NTIS HC A05/MF A01 CSCL 01B

On December 1, 1984, the FAA and NASA conducted a remotely piloted air-to-ground crash test of a Boeing 720 transport aircraft instrumented to measure crash loads of the structure and the anthropomorphic dummy passengers. Over 330 time histories of accelerations and loads collected during the Full-Scale Transport Controlled Impact Demonstration (CID) for the 1-sec period after initial impact are presented. Although a symmetric 1 deg. nose-up attitude with a 17 ft/sec sink rate was planned, the plane was yawed and rolled 13 deg. at initial (left-wing) impact. The first fuselage impact occurred near the nose wheel well with the nose pitched down 2.5 deg. Peak normal (vertical) floor accelerations were highest in the cockpit and forward cabin near the nose wheel well and were approximately 14G. The remaining cabin floor received normal acceleration peaks of 7G or less. The peak longitudinal floor accelerations showed a similar distribution, with the highest (7G) in the cockpit and forward cabin, decreasing to 4G or less toward the rear. Peak transverse floor accelerations ranged from about 5G in the cockpit to 1G in the aft fuselage. Author

N86-30722*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.
THE PERFORMANCE EVALUATION OF A JET FLAP ON AN ADVANCED SUPERSONIC HARRIER Final Report
Larry Dean Lipera and Doral R. Sandlin Aug. 1984 84 p
(Contract NCC2-238)
(NASA-CR-179653; NAS 1.26:179653) Avail: NTIS HC A05/MF A01 CSCL 01C

The performance concept of a supersonic vertical and short takeoff and landing (V/STOL) fighter, model 279-3, modified to utilize a jet flap was evaluated. Replacing the rear nozzles of the 279-3 with the jet flap favorably alters the pressure distribution over the airfoil and dramatically increases lift. The result is a significant decrease in takeoff distance, an increase in payload, and an improvement in combat performance. To investigate the

benefit in increased payload, the 279-3 and the jet flapped 279-3JF were modeled on the NASA Aircraft Synthesis (ACSYNT) computer code and flown on a 250 feet takeoff distance interdiction mission. The increase in payload weight that the 279-3JF could carry was converted into fuel in one case, and in another, converted to bomb load. When the fuel was increased, the 279-3JF penetrated into enemy territory almost four times the distance of 279-3, and therefore increased mission capability. When the bomb load was increased, the 279-3JF carried 14 bombs the same distance the 279-3 carried four. The increase in mission performance and improvements in turning rates was realized with only a small penalty in increased empty weight. Author

N86-30723*# National Aeronautics and Space Administration. Dryden (Hugh L.) Flight Research Center, Edwards, Calif.
MODIFIED US ARMY U-8F GROUND VIBRATION TEST
Michael W. Kehoe Aug. 1986 50 p
(NASA-TM-86741; H-1297; NAS 1.15:86741) Avail: NTIS HC A03/MF A01 CSCL 01C

The Dryden Flight Research Facility of NASA Ames Research Center conducted a ground vibration test on a modified U.S. Army U-8F airplane. Modifications included new engines, propellers, and engine-mounted truss assemblies. The ground vibration test was conducted using sine dwell, single-point random, and impact excitations. The test was performed to determine modal frequencies, mode shapes, and structural damping coefficients of the airframe and propeller with full and empty fuel tanks. The data presented include frequency response plots, rigid-body and structural modal frequencies, and mode shapes. Author

N86-30724# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LIQUID HYDROGEN FUELED PASSENGER AIRCRAFT
Yongnian Qian 11 Mar. 1986 11 p Transl. into ENGLISH from Hangkong Zhishi (China), no. 11, Nov. 1984 p 22-23
(AD-A166229; FTD-ID(RS)T-0862-85) Avail: NTIS HC A02/MF A01 CSCL 01/3

The idea that passenger aircraft will eventually use liquid hydrogen fuel is discussed. There is a large reserve of hydrogen and hydrogen poses no danger to the environment. Hydrogen has high calorific value, high specific heat, low density and low temperature. Aircraft will have to have a liquid fuel tank to carry the hydrogen and will have to be partially redesigned. Lockheed and NASA have considered such designs. A problem remains in the planning--the high cost of large extraction of liquid hydrogen. GRA

N86-30725# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
ELECTROSTATIC HAZARDS OF URETHANE PACKED FUEL TANKS Final Report, Mar. 1977 - Apr. 1978
Thomas C. Hillman, Jon R. Manheim, and George A. Spencer Mar. 1986 95 p
(AD-A166803; AFWAL-TR-82-2022) Avail: NTIS HC A05/MF A01 CSCL 13/12

An experiment investigation has been been carried out to determine the primary factors that have contributed to recent aircraft electrostatically induced ground refueling fire incidents. It was found that the explosion suppression open pore polyurethane fuel tank foams along with the charging characteristics of the JP-4 fuel resulted in charge accumulation and electrostatic spark discharging. The polyurethane foams accumulated charge due to their highly resistive nature (blue, 10 to the 15th power ohm-cm; red, 10 to the 14th power ohm-cm; yellow, to the 14th power ohm-cm; and orange, 10 to the 13th power ohm-cm). The fuel flow rate and velocity entering the tank and impinging on the open pore polyurethane foam directly affected the magnitude of the charge separation which was occurring. The number of refuelings that had taken place also was a critical factor due to its effect on charge accumulation/discharge frequency levels. The last major variable investigated was pro-static (Gulf-178) and conductivity improving (shell ASA-3) fuel additives. The Gulf-178 additive dramatically increased the levels of charge separation and accumulation taking place along with a reversal in the polarity of charge. The Shell ASA-3 fuel additive eliminated the aircraft ground refueling electrostatic discharge hazard decreasing the level of charge accumulation. GRA

N86-30726# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Strucutures and Materials Panel.
THE INFLUENCE OF LARGE-SCALE COMPUTING ON AIRCRAFT STRUCTURAL DESIGN
Apr. 1986 67 p
(AGARD-R-726; ISBN92-835-1522-6) Avail: NTIS HC A04/MF A01

An outcome of the AGARD Working Group on Large Scale Computing was the institution by the Structures and Materials Panel of a Sub-Committee to consider this topic in relation to Aircraft Structural design. The publication contains papers on various aspects of the topic heard by the Sub-Committee plus a summary. These cover likely developments in both soft- and hardware, and their applications to the Design process. This Report was sponsored by the Structures and Materials Panel of AGARD. Author

N86-30727# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
STORE SEPARATION FLIGHT TESTING
R. J. Arnold, C. S. Epstein, and R. K. Bogue, ed. Apr. 1986 161 p
(AGARD-AG-300-Vol-5; ISBN92-835-1523-4) Avail: NTIS HC A08/MF A01

This volume in the AGARD Flight Test Techniques Series treats stores separation testing from the overall systems standpoint. All aspects of testing are described from the time of identification of a particular aircraft/store requirement through all steps leading to the establishment of a satisfactory employment envelope. Considerable emphasis is placed on the planning and execution of the flight test phase of the stores clearance program, including the definition of a basic structure, and a set of procedures which will maximize the safe and efficient execution of such a program. Author

N86-30654# Grumman Aerospace Corp., Bethpage, N.Y.
THE APPLICATION OF PRACTICAL OPTIMIZATION TECHNIQUES IN THE PRELIMINARY STRUCTURAL DESIGN OF A FORWARD-SWEPT WING
Edwin Lerner *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 381-392 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30655# Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.
STRUCTURAL OPTIMIZATION PROGRAMS AND METHODS
A. J. Morris *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 393-406 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30656# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
VARIATION OF ANISOTROPIC BEHAVIOR IN STRUCTURAL OPTIMIZATION
G. Hornung, D. W. Mathias, and H. Roehrle *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 407-414 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30660# Tel-Aviv Univ. (Israel). Faculty of Engineering.
RECENT RESULTS ON THE WEIGHT MINIMIZATION OF PANELS WITH A FLUTTER SPEED CONSTRAINT
L. Librescu and L. Beiner *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 441-450 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30662# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
AEROELASTIC PROBLEMS AND STRUCTURAL DESIGN OF A TAILLESS CARBON FIBER COMPOSITE (CFC) SAILPLANE
J. Schweiger, O. Sensburg, and H. J. Berns (Technische Univ., Brunswick, West Germany) *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 457-468 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30685# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
STRUCTURAL DYNAMIC ASPECTS OF ROTOR NODAL ISOLATION
J. Stoppel *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 486-494 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30678# Northwestern Polytechnical Univ., Xian (China). Dept. of Aircraft Engineering.
DETERMINATION OF NATURAL VIBRATION PROPERTIES OF A WING WITH WINGLET BY EXPERIMENTAL MODE SYNTHESIS TECHNIQUE
S. N. Gu, W. J. You, and J. S. Jiang *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 605-611 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30679# Israel Aircraft Industries Ltd., Ben-Gurion Airport.
RAPID VIBRATION MODE ANALYSIS OF AIRCRAFT WITH EXTERNAL STORES
M. Karpel *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 612-616 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N86-30728# Aerojet Electrosystems Co., Azusa, Calif.
DESIGN, DEVELOPMENT AND INTEGRATE/INSTALL AN AIRBORNE REMOTE INSTRUMENTATION SYSTEM (AIREYE) Final Report
J. J. Bommarito and L. E. Saylor Aug. 1985 79 p
(Contract DTCG23-80-C-20012)
(AD-A166755; Rept-7921; USCG-D-27-85) Avail: NTIS HC A05/MF A01 CSCL 01/3

A prototype airborne remote instrument system, AIREYE, was developed for the U.S. Coast Guard by Aerojet ElectroSystems Company. This multisensor system permits real-time day/night, all weather detection, mapping and documentation of vessels and pollution at sea. The system was installed aboard a coast Guard Hu-25A Falcon fanjet aircraft and flight tested off the California coast. Surveillance data were obtained from natural oil seeps, known optical and radar targets, routine shipping and targets of opportunity. The AIREYE system consists of a sidelooking radar, infrared/ultraviolet line scanner, active gated television systems, aerial reconnaissance camera and a processor/display recording subsystem with real-time digital image enhancement capability. The system reliably detected and mapped oil seeps and vessel locations for environmental conditions ranging from dense undercast to clear, windspeeds from 0 to greater than 25 knots and from daytime to total darkness. The ability to read a vessel's name and determine deck activity in total darkness was demonstrated. The AIREYE real-time digital enhancement provided detection, recognition and identification of targets of interest when not otherwise possible with unenhanced imagery. Test results demonstrated that the AIREYE system will provide greatly enhanced capability in the U.S. Coast Guard missions of Marine Environmental Protection (MEP), Enforcement of Laws and Treaties and Search and Rescue. Author (GRA)

N86-30729# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
AIRBORNE NAVIGATION REMOTE MAP READER EVALUATION Final Report, 1 Sep. 1984 - 30 Sep. 1985
James C. Byrd Mar. 1986 56 p
(AD-A166976; ASD-TR-86-5004) Avail: NTIS HC A04/MF A01 CSCL 01/3

The U.S. Air Force evaluated the Full-Color Remote Map Reader built by Thomson-CSF of France under the Foreign Weapons, Equipment, and Technology Evaluation program. The unit is used in a military aircraft to provide a moving map video display for the aircrew. Map data is contained in a 65-foot roll of 35mm film at 11.4:1 reduction, which allows approximately 550 sq. ft. of aeronautical charts of any standard scale to be stored in one cassette. The unit moves the film with microprocessor-controlled servo motors and performs scanning, rotation and zoom with a microprocessor-controlled flying spot scanner. It obtains navigation data from the aircraft MIL-STD-1553 data bus and presents video on a full-color, shadow-mask cathode ray tube. The evaluation determined that the moving map display is useful in several Air Force missions, and that the French map reader technology is roughly equivalent to devices recently developed in the U.S. Author (GRA)

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N86-30730*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
UNSTEADY DESIGN-POINT FLOW PHENOMENA IN TRANSONIC COMPRESSORS Final Report
J. B. Gertz and A. H. Epstein Aug. 1986 210 p
(Grant NGL-22-009-383)
(NASA-CR-176879; NAS 1.26:176879) Avail: NTIS HC A10/MF A01 CSCL 21E

High-frequency response probes which had previously been used exclusively in the MIT Blowndown Facility were successfully employed in two conventional steady state axial flow compressor facilities to investigate the unsteady flowfields of highly loaded transonic compressors at design point operation. Laser anemometry measurements taken simultaneously with the high response data were also analyzed. The time averaged high response data of static and total pressure agreed quite well with the conventional steady state instrumentation except for flow angle which showed a large spread in values at all radii regardless of the type of instrumentation used. In addition, the time resolved measurements confirmed earlier test results obtained in the MIT Blowdown Facility for the same compressor. The results of these tests have further revealed that the flowfields of highly loaded transonic compressors are heavily influenced by unsteady flow phenomena. The high response measurements exhibited large variations in the blade to blade flow and in the blade passage flow. The observed unsteadiness in the blade wakes is explained in terms of the rotor blades' shed vorticity in periodic vortex streets. The wakes were modeled as two-dimensional vortex streets with finite size cores. The model fit the data quite well as it was able to reproduce the average wake shape and bi-modal probability density distributions seen in the laser anemometry data. The presence of vortex streets in the blade wakes also explains the large blade to blade fluctuations

seen by the high response probes which is simply due to the intermittent sampling of the vortex street as it is swept past a stationary probe. Author

N86-30731*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.
THERMODYNAMIC EVALUATION OF TRANSONIC COMPRESSOR ROTORS USING THE FINITE VOLUME APPROACH Status Report
Stephen Nicholson and John Moore Aug. 1986 292 p
(Grant NAG3-593)
(NASA-CR-176947; NAS 1.26:176947; JM/86-6) Avail: NTIS HC A13/MF A01 CSCL 21E

A method was developed which calculates two-dimensional, transonic, viscous flow in ducts. The finite volume, time marching formulation is used to obtain steady flow solutions of the Reynolds-averaged form of the Navier Stokes equations. The entire calculation is performed in the physical domain. The method is currently limited to the calculation of attached flows. The features of the current method can be summarized as follows. Control volumes are chosen so that smoothing of flow properties, typically required for stability, is now needed. Different time steps are used in the different governing equations to improve the convergence speed of the viscous calculations. A new pressure interpolation scheme is introduced which improves the shock capturing ability of the method. A multi-volume method for pressure changes in the boundary layer allows calculations which use very long and thin control volumes. A special discretization technique is also used to stabilize these calculations. A special formulation of the energy equation is used to provide improved transient behavior of solutions which use the full energy equation. The method is then compared with a wide variety of test cases. The freestream Mach numbers range from 0.075 to 2.8 in the calculations. Transonic viscous flow in a converging diverging nozzle is calculated with the method; the Mach number upstream of the shock is approximately 1.25. The agreement between the calculated and measured shock strength and total pressure losses is good. Essentially incompressible turbulent boundary layer flow in a adverse pressure gradient is calculated and the computed distribution of mean velocity and shear stress are in good agreement with the measurements. At the other end of the Mach number range, a flat plate turbulent boundary layer with a freestream Mach number of 2.8 is calculated using the full energy equation; the computed total temperature distribution and recovery factor agree well with the measurements when a variable Prandtl number is used through the boundary layer. Author

N86-30732*# Systems Control Technology, Inc., Palo Alto, Calif.
ROBUST DETECTION, ISOLATION AND ACCOMMODATION FOR SENSOR FAILURES Final Report
Abbas Emami-Naeini, Muhammad M. Akhter, and Stephen M. Rock Jul. 1986 164 p
(Contract NAS3-24079)
(NASA-CR-174825; NAS 1.26:174825; SCT-85-5449) Avail: NTIS HC A08/MF A01 CSCL 21E

The objective is to extend the recent advances in robust control system design of multivariable systems to sensor failure detection, isolation, and accommodation (DIA), and estimator design. This effort provides analysis tools to quantify the trade-off between performance robustness and DIA sensitivity, which are to be used to achieve higher levels of performance robustness for given levels of DIA sensitivity. An innovations-based DIA scheme is used. Estimators, which depend upon a model of the process and process inputs and outputs, are used to generate these innovations. Thresholds used to determine failure detection are computed based on bounds on modeling errors, noise properties, and the class of failures. The applicability of the newly developed tools are demonstrated on a multivariable aircraft turbojet engine example. A new concept call the threshold selector was developed. It represents a significant and innovative tool for the analysis and synthesis of DiA algorithms. The estimators were made robust by introduction of an internal model and by frequency shaping. The internal mode provides asymptotically unbiased filter estimates. The incorporation of frequency shaping of the Linear Quadratic Gaussian cost functional modifies the estimator design to make it suitable for sensor failure DIA. The results are compared with previous studies which used thresholds that were selcted empirically. Comparison of these two techniques on a nonlinear dynamic engine simulation shows improved performance of the new method compared to previous techniques Author

N86-30733*# Detroit Diesel Allison, Indianapolis, Ind.
FEASIBILITY STUDY FOR CONVERTIBLE ENGINE TORQUE CONVERTER
Oct. 1985 72 p
(Contract NAS3-24092)
(NASA-CR-175082; NAS 1.26:175082; EDR-12118) Avail: NTIS HC A04/MF A01 CSCL 21E

The feasibility study has shown that a dump/fill type torque converter has excellent potential for the convertible fan/shaft engine. The torque converter space requirement permits internal housing within the normal flow path of a turbofan engine at acceptable engine weight. The unit permits operating the engine in the turboshaft mode by decoupling the fan. To convert to turbofan mode, the torque converter overdrive capability bring the fan speed up to the power turbine speed to permit engagement of a mechanical lockup device when the shaft speed are synchronized. The conversion to turbofan mode can be made without drop of power turbine speed in less than 10 sec. Total thrust delivered to the aircraft by the proprotor, fan, and engine during tansient can be controlled to prevent loss of air speed or altitude. Heat rejection to the oil is low, and additional oil cooling capacity is not required. The turbofan engine aerodynamic design is basically uncompromised by convertibility and allows proper fan design for quiet and efficient cruise operation. Although the results of the feasibility study are exceedingly encouraging, it must be noted that they are based on extrapolation of limited existing data on torque converters. A component test program with three trial torque converter designs and concurrent computer modeling for fluid flow, stress, and dynamics, updated with test results from each unit, is recommended. Author

N86-30734# Exotech, Inc., Campbell, Calif.
TIME RESOLVED AND TIME AVERAGED FLOW EVALUATION FOR AN ISOLATED TRANSONIC COMPRESSOR ROTOR Final Report
F. Neuhoff Mar. 1986 61 p
(Contract N00014-84-C-0766)
(AD-A166759; TR-8601) Avail: NTIS HC A04/MF A01 CSCL 20/4

A 0.28-m single stage transonic fan was operated in a rotor only configuration. Overall performance was measured and radial distributions of inlet and outlet velocity were obtained using time-averaging combination temperature-pneumatic probes. These results were compared to the prediction of a finite element computer code (TURBOFEM) prediction. The blade-to-blade velocity and pressure distributions were measured using the Dual Probe Digital Sampling technique (involving two commercial semi-conductor probes of simple design). Data were obtained from hub-to-tip at both near-sonic and at supersonic inlet relative Mach numbers. The rotor losses were derived as blade-to-blade distributions and the shock losses were evaluated as components of the total loss at each radius. Based on the limited data obtained near sonic conditions, a combination of the profile loss model of Koch & Smith and shock loss model of Dunker was found to predict the measured radial loss distribution quite well. Preliminary observations of rotor shock oscillations were also reported. Compressor rotors, Compressor stators, Transonic flow, Turbomachinery flow fields, Transonic loss measurements, and Finite element codes. GRA

N86-30735# Doellner (O. Leonard), Tucson, Ariz.
JET-ENGINE COMBUSTOR SPECTRAL RADIATION MEASUREMENTS USING FIBEROPTIC INSTRUMENTATION SYSTEM. RADIANT ENERGY POWER SOURCE FOR JET AIRCRAFT Final Report

O. Leonard Doellner Feb. 1986 121 p
(Contract DE-FG01-82CE-15144)
(DE86-007289; DOE/CE-15144/T2) Avail: NTIS HC A06/MF A01

This report is a summary of spectral radiation measurements made at Williams Air Force Base, Chandler, Arizona on a General Electric J-85-5 engine. The spectral radiation measurements consisted of a complete axial profile down the combustor and are directed toward the application of Radiant Energy Power Source for Jet Aircraft. Radiant Energy Power Source for Jet Aircraft relates to the use of photovoltaic cells to generate the electrical power demands of the aircraft. The photovoltaic cells are mounted inside the casing of the jet engine, are thermally insulated from the normally hot engine casing, and are appropriately cooled. The photovoltaic cells receive their required radiant energy from the combustion flame by holes in the combustion liner. The instrumentation system used to make these measurements employed fiberoptic probes - entering the engine by way of an existing (modified) access plate - to obtain the radiation measurements. Such an instrumentation system has the strong advantage of being able to measure radiation from all the holes running axially down the combustor without making any holes in the plenum/engine casing - as would be necessary if sapphire observation windows were used. DOE

N86-30664# Liege Univ. (Belgium).
DYNAMIC ANALYSIS OF STRUCTURES WITH FLEXIBLE ROTORS
M. Geradin and N. Kill *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 477-485 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N86-30736*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronatuical Engineering.
LONGITUDINAL STABILITY AND CONTROL DERIVATIVES OBTAINED FROM FLIGHT DATA OF A PA-30 AIRCRAFT Final Report
Dale R. Turley and Doral R. Sandlin Apr. 1981 60 p
(Contract NCC4-1)
(NASA-CR-176999; NAS 1.26:176999) Avail: NTIS HC A04/MF A01 CSCL 01C

In order to obtain reliable and accurate values of the stability and control derivatives, the Dryden Fligh Research Center (DFRC) developed a technique for extracting the derivatives from flight data. This technique is implemented by a set of FORTRAN computer programs that is based on a modified maximum likelihood estimator that uses the Newton-Raphson algorithm to perform the required minimization of the derivatives. Data was obtained with a PA-30, light twin-engine general aviation aircraft in zero, half, and full flap configuration in level unaccelerated flight with the landing gear retracted. The derivatives were plotted as functions of angle of attack using various graphical arrangements to show variations of wind tunnel and flight determined values at zero flap settings. Also, data was displayed to show the effects of flap deflection and thrust variation on the longitudinal stability derivatives. The angle of attack and angle of sideslip were measured. The dynamic pressure, velocity, and altitude were calculated, using a FORTRAN computer program, from the static and dynamic pressures. The control deflections of the stabilator, ailerons, and rudder also were recorded along with left throttle position, engine rpm, and manifold pressure. B.G.

N86-30737*# Purdue Univ., West Lafayette, Ind. School of Aeronautics and Astronautics.
THE INTEGRATED MANUAL AND ATUOMATIC CONTROL OF COMPLEX FLIGHT SYSTEMS Semiannual Status Report, Jul. 1984 - Mar. 1985
David K. Schmidt 12 Apr. 1985 68 p
(Grant NAG4-1)
(NASA-CR-176940; NAS 1.26:176940) Avail: NTIS HC A04/MF A01 CSCL 01C

The flight test results obtained recently (1984) by CALSPAN on pitch-rate flight control systems in the flared landing task, obtained with the Total In-Flight Simulator (TIPS), were analyzed. The analysis approach considered is based on the Optimal Control/Frequency Domain (OC/FD) techniques. These techniques originally stem from an optimal-control approach to perform a Neal-Smith-like analysis on aircraft attitude dynamics, but were extended and used successfully to analyze the flared landing task. B.G.

N86-30738*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.
A SURVEY OF HANDLING QUALITIES CRITERIA AND THEIR APPLICATIONS TO HIGH PERFORMANCE AIRCRAFT Final Report
David L. Peahl, Faysal Kolkailah, and Doral R. Sandlin Jan. 1986 68 p
(Contract NCC2-338)
(NASA-CR-179654; NAS 1.26:179654) Avail: NTIS HC A04/MF A01 CSCL 01C

Various handling qualities criteria and their application to high performance aircraft including state-of-the-art and highly augmented aircraft were surveyed. Neal-Smith, Bandwidth, Equivalent Systems, and Military Specification 8785 criteria are applied to flight test data from aircraft such as the F-8 Digital Fly-By-Wire, the YF-12, and an Advanced Fighter Aircraft. Backgrounds and example applications of each criteria are given. The results show that the handling qualities criteria investigated can be applied to highly augmented aircraft with fairly good results in most cases; however, since no one method excelled, more than one criteria should be used whenever possible. Equivalent time delays appear to be the most frequent critical factor in determining pilot rating levels of highly augmented aircraft. Author

N86-30739# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AIRCRAFT RESPONSE TO TURBULENCE
1985 32 p Presented at the 61st Meeting of the Structures and Materials Panel of AGARD, Oberammergau, West Germany, 8-13 Sep. 1985
(AGARD-R-738; ISBN92-835-0393-7) Avail: NTIS HC A03/MF A01

In 1985 the Structures and Materials Panel initiated an activity to consider the flight of flexible aircraft in turbulence. As a preliminary to the start of this activity, the Panel heard the two papers included in this report. One of the two papers discusses measurements of time histories of turbulence made by specially equipped aircraft and turbulence event statistics obtained from aircraft in commercial operation. The other paper considers aspects of collection and analysis of flight data, methods of calculating aircraft response and constraints in operation. Author

N86-30740# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
APPLICATION OF Ada HIGHER ORDER LANGUAGE TO GUIDANCE AND CONTROL
May 1986 106 p Presented at a Lecture Series, Ottawa, Ontario, 20-21 May 1986; London, England, 2-3 Jun. 1986; and Cologne, West Germany, 5-6 Jun. 1986; sponsored by the Guidance and Control Panel and the Consultant and Exchange Programme of AGARD
(AGARD-LS-146; ISBN92-835-1527-7) Avail: NTIS HC A06/MF A01

The need to reduce escalating software life-cycle costs is the rationale for Ada. Early experience with the language suggests that the promise of increased software productivity can be fulfilled.

However, many problems remain; the need for validated and efficient compilers targeted for computers suitable to the guidance and control application, and software development environments built around Ada, are two among the foremost. This Lecture Series, sponsored by the Guidance and Control Panel of AGARD, has been implemented by the Consultant and Exchange Programme of AGARD. Author

N86-30741# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
GUST LOAD PREDICTION AND ALLEVIATION ON A FIGHTER AIRCRAFT
J. Becker Jun. 1986 22 p Presented at the 61st Meeting of the Structures and Materials Panel of AGARD, Oberammergau, West Germany, 8-13 Sep. 1985
(AGARD-R-728; ISBN92-835-1532-3) Avail: NTIS HC A02/MF A01

In 1985 the AGARD Structures and Materials Panel initiated an activity on the flight of flexible aircraft in turbulence. As a preliminary the Panel heard this paper which discusses the influence of turbulence -induced dynamic loads on the structural design of fighter aircraft. Methods for calculating dynamic response are given, and the problems associated with improved ride are considered. Author

N86-30630# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
APPLICATION OF TRANSONIC UNSTEADY METHODS FOR CALCULATION OF FLUTTER AIRLOADS
H. Zimmermann and S. Vogel *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 47-61 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30635# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Aeroelasticity.
THEORETICAL FLUTTER INVESTIGATIONS ON A PLANE CASCADE IN INCOMPRESSIBLE FLOW
V. Carstens *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 169-179 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30637# Northwestern Polytechnical Univ., Xian (China).
A NUMERICAL ANALYSIS FOR VERTICAL GUST FIELD INDUCED BY GUST GENERATOR
Yongnian Yang and Jianpei Wang *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 187-193 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30642# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
A REVIEW OF AEROELASTIC RESEARCH AT THE FLIGHT DYNAMICS LABORATORY
T. M. Harris, T. E. Noll, T. J. Hertz, and W. A. Sotomayer *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 233-243 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30643# Fairchild Republic Div., Farmingdale, N. Y.
AEROELASTIC WIND TUNNEL SIMILARITY THEORY FOR ANISOTROPIC AIRCRAFT WINGS
Gabriel A. Oyibo *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 257-264 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30644# British Aerospace Dynamics Group, Hatfield (England). Civil Div.
THE CHOICE OF TECHNIQUES USED FOR FLIGHT FLUTTER CLEARANCE WITH PARTICULAR REFERENCE TO THE BAe 146 AND BAe 125
A. G. Woods *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 265-275 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30645# Saab-Scania, Linkoping (Sweden).
FLUTTER CALCULATION BY A NEW PROGRAM
Valter J. E. Stark *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 276-285 Sponsored by Swedish Defence Administration and Saab Scania A.B. (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30647# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DEVELOPMENT OF A FLUTTER SUPPRESSION CONTROL LAW BY USE OF LINEAR QUADRATIC GAUSSIAN AND CONSTRAINED OPTIMIZATION DESIGN TECHNIQUES
William M. Adams and Sherwood H. Tiffany *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 297-308 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03 CSCL 01B

N86-30649# National Aerospace Lab., Amsterdam (Netherlands). Dept. of Aeroelasticity.
NLR EXPERIENCE IN THE APPLICATION OF ACTIVE FLUTTER SUPPRESSION AND GUST LOAD ALLEVIATION, APPLIED TO A WIND TUNNEL MODEL
P. A. vanGelder *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 320-329 Sponsored by Netherlands Agency for Aerospace Programs and NLR (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30650# Royal Aircraft Establishment, Farnborough (England).
THE DESIGN AND WIND TUNNEL DEMONSTRATION OF AN ACTIVE CONTROL SYSTEM FOR GUST LOAD ALLEVIATION AND FLUTTER SUPPRESSION
I. W. Kaynes, C. W. Skingle, and J. C. Copley *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 330-347 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30651# Northwestern Polytechnical Univ., Xian (China).
CONTROL LAW SYNTHESIS FOR GUST LOAD ALLEVIATION USING LINEAR QUADRATIC GAUSSIAN THEORY
Jin Chang *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 362-367 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30657# Purdue Univ., West Lafayette, Ind. School of Aeronautics and Astronautics.
TAILORING METHODOLOGY FOR AEROELASTIC STABILITY AND LATERAL CONTROL ENHANCEMENT
Terrance A. Weisshaar *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 415-425 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N86-30742# Transportation Systems Center, Cambridge, Mass.
AIRPORT CAPACITY ENHANCEMENT PLAN Final Report, Nov.

1984 - Jan. 1986
1986 172 p
(AD-A166686; DOT-TSC-FAA-86-2; DOT/FAA/CT-86/1) Avail: NTIS HC A08/MF A01 CSCL 05/1

The first edition of the Airport Capacity Enhancement Plan has been developed by the Federal Aviation Administration's newly established Airport Capacity Program Office (ACPO). The plan is intended to increase the capacity and efficient utilization of airports, and to alleviate current and projected aircraft operating delays in the nation's airport system without compromises to safety or to the environment. This plan delineates the goals of the capacity enhancement program. It identifies the concerns of air system users and defines the extent and causes of the capacity and delay problem as it currently exists and is projected for the next decade. The allocation of responsibility for capacity and delay activities within the FAA is discussed. The 53 planned and ongoing FAA projects intended to reduce capacity-related problems are identified. The plan provides descriptions of each of these projects, significant milestones, estimates of their capacity-related benefits, and references to more detailed descriptions of each project. GRA

N86-30663# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. of Aeroelasticity.
SIMULATION OF AIRCRAFT TAXI TESTING ON THE AGILE SHAKER TEST FACILITY
Raymond Freymann and William P. Johnson (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio) *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 468-476 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30967# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
EUROPEAN ECONOMIC COMMUNITY (EEC) TEST STAND COMPARISON [VERGLEICH DER EG-PRUEFSTAENDE]
B. Harbrink *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 82-116 In GERMAN Original document contains color illustrations (For primary document see N86-30962 22-34)
Avail NTIS HC A20/MF A01

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N86-30743*# South Carolina Univ., Columbia.
THE ASSOCIATION OF SCHOOLS OF JOURNALISM AND MASS COMMUNICATION JOURNALIST-IN-SPACE PROJECT Final Report
31 Jul. 1986 22 p
(Contract NCCW-6)
(NASA-CR-176961; NAS 1.26:176961) Avail: NTIS HC A02/MF A01 CSCL 22A

During the summer of 1985, NASA asked the Association of Schools of Journalism and Mass Communication (ASJMC) to select a U. S. journalist who could ride aboard the space shuttle and report the experience to the American public. Eligibility critieria and selection procedures are discussed. The forty semifinalists are listed. B.G.

N86-30744*# Colorado Univ., Boulder. Center for Space Law and Policy.
A STUDY OF FACTORS RELATED TO COMMERCIAL SPACE PLATFORM SERVICES
S. Neil Hosenball Aug. 1986 254 p
(Grant NAGw-884)
(NASA-CR-176881; NAS 1.26:176881) Avail: NTIS HC A12/MF A01 CSCL 22A

In the past four years, the issue of the commercial development of space has come to the forefront of the U. S. national space policy. Though the Administration, Congress and NASA have all shown strong support for encouraging the private sector to become more actively involved in the commercial utilization of space, the question remains whether they must do more to foster the creation and development of a viable U. S. commercial space industry. Marketing aspects, insurance and risk loss, tax related factors, space transportation, termination liability, institutional barriers, and procurement laws and regulations are discussed. B.G.

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

N86-30745# Hatfield Polytechnic (England). Numerical Optimization Center.
PRELIMINARY STUDY OF THE USE OF LAPLACE AND MOMENTUM VECTORS IN THE DETERMINATION OF INTERPLANETARY LOW THRUST TRAJECTORIES
M. C. Bartholomew-Biggs, L. C. W. Dixon, and S. E. Hersom Jul. 1985 32 p
(Contract ESA-6134/84-D-JS(SC))
(ESA-CR(P)-2173; ESA-86-97219) Avail: NTIS HC A03/MF A01

The feedback and Pontryagin approaches to the optimization of low thrust trajectories using the momentum and Laplace vectors are considered. The feedback algorithm runs into numerical difficulties at the final point and at intermediary points where the efficiencies are low. These difficulties can be avoided by using the switching function, but impractical trajectories can still occur and hence cause trouble if this happens inside an optimization routine. The algorithm readily produces final orbits which are correct except for the argument of perihelion, but is of no practical use to proceed beyond this point. In the Pontryagin approach, the use of the first order approximation, in which the adjoint variables are assumed constant, is justified. This enables optimization to be undertaken with a much shorter computer time per iteration and with little degradation in performance. ESA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air).*

N86-30746*# Stanford Univ., Calif. Space, Telecommunications and Radioscience Lab.
REMOTE SCIENCE OPERATION CENTER RESEARCH Semiannual Report
Peter M. Banks 1 Jul. 1986 80 p Sponsored by NASA
(NASA-CR-176869; NAS 1.26:176869; SEL-39-85) Avail: NTIS HC A05/MF A01 CSCL 14B

Progress in the following areas is discussed: the design, planning and operation of a remote science payload operations control center; design and planning of a data link via satellite; and the design and prototyping of an advanced workstation environment for multi-media (3-D computer aided design/computer aided engineering, voice, video, text) communications and operations. B.G.

N86-30747# Department of the Navy, Washington, D. C.
GROUND LAUNCHED MISSILE CONTROLLED RATE DECELERATOR Patent

Harold G. Brittain and Charles B. Brantley, inventors (to Navy) Issued 11 Mar. 1986 8 p
(AD-D012212; US-Patent-4,575,026; US-Patent-Appl-SN-626958; US-Patent-Class-244-63) Avail: NTIS US Patent and Trademark Office CSCL 16/1

This patent discloses a deceleration sled to decelerate and safely contain a launched test missile. The sled has crushable honeycomb which absorbs the initial impact of the missile as the sled accelerates along a track to the same speed as the missile. As the deceleration sled is pushed down the rails, forming shoes on both sides of the sled engage flat metal plates. The forming shoes roll the flat plates into a U shape. The energy required to roll these plates can be changed by varying their thickness. GRA

N86-30748# Los Alamos National Lab., N. Mex.
HIMASS ELECTROMAGNETIC LAUNCHER AT LOS ALAMOS
E. L. Zimmermann, C. M. Fowler, E. Foley, and J. V. Parker 1986 4 p Presented at the 3rd Symposium on Electromagnetic Launch Technology, Austin, Tex., 20-24 Apr. 1986
(Contract W-7405-eng-36)
(DE86-008734; LA-UR-86-925; CONF-8604147-6) Avail: NTIS HC A02/MF A01

The HIMASS electromagnetic launcher is a unique large-bore, large-mass railgun driven by a helical flux compression generator. Two experiments were conducted at 3 to 4 MA current levels. The objective of the experiments was to study the effects of scaling, ablation, and material parameters on electromagnetic launcher performance. Data from these two experiments are presented. DOE

N86-30749# Los Alamos National Lab., N. Mex.
RAILGUNS POWERED BY EXPLOSIVE DRIVEN FLUX COMPRESSION GENERATORS
C. M. Fowler, E. L. Zimmermann, C. E. Cummings, R. F. Davidson, E. Foley, R. S. Hawke, J. F. Kerrisk, J. V. Parker, W. M. Parsons, D. R. Peterson et al 1986 7 p Presented at the 3rd Symposium on Electromagnetic Launch Technology, Austin, Tex., 20-24 Apr. 1986 Prepared in cooperation with LLNL, Calif. and Texas Univ., Austin
(Contract W-7405-eng-36)
(DE86-008735; LA-UR-86-926; CONF-8604147-8) Avail: NTIS HC A02/MF A01

Explosive driven flux compression generators (FCG's) are single-shot devices that convert part of the energy of high explosives into electromagnetic energy. Some classes of these generators have served quite well as railgun power sources. In this paper and the following paper we describe strip and helical type FCG's, both of which are in use in the Los Alamos railgun program. Advantages and disadvantages these generators have for railgun power supplies will be discussed, together with experimental results obtained and some of the diagnostics we have found particularly useful. DOE

N86-30750# Los Alamos National Lab., N. Mex.
LAUNCHER BARREL FOR THE LETHALITY TEST SYSTEM RAILGUN
J. R. Sims, K. E. Christensen, C. E. Cummings, and N. C. Calkins 1986 5 p Presented at the 3rd Symposium on Electromagnetic Launch Technology, Austin, Tex., 20-24 Apr. 1986
(Contract W-7405-eng-36)
(DE86-008739; LA-UR-86-942; CONF-8604147-7) Avail: NTIS HC A02/MF A01

A reusable plasma armature railgun barrel design is described. This barrel was designed and is being fabricated at the Los Alamos National Laboratory for use in a kinetic energy lethality test system. The performance goals for this barrel are (1) that it be able to withstand the loads generated when accelerating a 30-g projectile to a velocity of 15 km/s without sustaining permanent damage, (2) that it have multiple shot capability, and (3) that it be capable of being repaired and/or modified. The barrel consists of a multipiece modular core contained in an outer structural shell. The core assembly, composed of rails and insulators, is accessible for repair or replacement. The outer structural shell is designed to allow access to the core and is used to preload the core compressively. The barrel design incorporates various features that will allow the use of stronger and stiffer materials such as structural ceramics and reinforced coppers as they become available. DOE

N86-30751# Los Alamos National Lab., N. Mex.
PREDICTING BORE DEFORMATIONS AND LAUNCHER STRESSES IN6 RAILGUNS
R. F. Davidson, W. A. Cook, D. A. Rabern, and N. M. Schnurr 1986 7 p Presented at the 3rd Symposium on Electromagnetic Launch Technology, Austin, Tex., 20 Apr. 1986
(Contract W-7405-eng-36)
(DE86-008738; LA-UR-86-941; CONF-8604147-2) Avail: NTIS HC A02/MF A01

The structural responses of launchers are important because they affect the projectile performance and the operating limits of the railgun system. Structural analysis makes it possible to make better decisions in launcher design. Example analyses of the Los Alamos HIMASS and Lethality Test System launchers are presented in this paper. Also, a discussion of the benefits and limitations of these analyses is included. DOE

N86-30752# Los Alamos National Lab., N. Mex.
RAILGUN CONDUCTOR HEATING FROM MULTIPLE CURRENT PULSES
J. F. Kerrisk 1986 7 p Presented at the 3rd Symposium on Electromagnetic Launch Technology, Austin, Tex., 20 Apr. 1986
(Contract W-7405-eng-36)
(DE86-008724; LA-UR-86-815; CONF-8604147-4) Avail: NTIS HC A02/MF A01

A numerical technique for solving current- and thermal-diffusion problems in railgun conductors has been used to study joule heating in rails that are subject to multiple current pulses. Copper rails that are 25 mm high by the 12.5 mm wide with a 20-mm-square bore and a current pulse with 1-MA peak current and 1-ms pulse width at half maximum were assumed. This combination of parameters is sufficient to accelerate an 80-g projectile to 2-3 km/s with which current pulse. Three parameters were varied in the analysis: the repetition rate or current pulse frequency (3.3 to 100 Hz), the coolant heat-transfer coefficient (5 x 10(4) and 5 x 10(5) W/m(2) .K), and the coolant channel distribution in the rail. Detailed results are used to illustrate the acceptability or unacceptability of particular combinations of these parameters for operation at steady state. An uncooled rail was not acceptable for steady-state operation. Repetition rates of about 30 Hz were acceptable with the higher coolant heat-transfer coefficient and the best coolant-channel distribution; this included cooling the rail exterior surface. DOE

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N86-30753*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A MECHANICAL PROPERTY AND STRESS CORROSION EVALUATION OF VIM-ESR-VAR WORK STRENGTHENED AND DIRECT DOUBLE AGED INCONEL 718 BAR MATERIAL
J. W. Montano Sep. 1986 37 p
(NASA-TP-2634; NAS 1.60:2634) Avail: NTIS HC A03/MF A01 CSCL 11F

Presented are the mechanical properties and the stress corrosion resistance of triple melted [vacuum arc remelted (VIM), electro-slag remelted (ESR), and vacuum arc remelted (VAR)], solution treated, work strengthened and direct double aged Inconel 718 alloy bars [4.00 in. (10.16) and 5.75 in. (14.60 cm) diameter]. Tensile, charpy v-notched impact, and compact tension specimens were tested at ambient temperature in both the longitudinal and

transverse directions. Longitudinal tensile and yield strengths in excess of 220 ksi (1516.85 MPa) and 200 ksi (1378.00 MPa) respectively, were realized at ambient temperature. Additional charpy impact and compact tension tests were performed at -100 F (-73 C). Longitudinal charpy impact strength equalled or exceeded 12.0 ft-lbs (16.3 Joules) at ambient and at -100 F(-73 C) while longitudinal compact (LC) tension fracture toughness strength remained above 79 ksi (86.80 MPa) at ambient and at -100 F(-73 C) temperatures. No failures occurred in the longitudinal or transverse tensile specimens stressed to 75 and 100 percent of their respective yield strengths and exposed to a salt fog environment for 180 days. Tensile tests performed after the stress corrosion test indicated no mechanical property degradation.
Author

N86-30754# Los Alamos National Lab., N. Mex.
LOW-THRUST ROCKET TRAJECTORIES
P. W. Keaton Jan. 1986 21 p
(Contract W-7405-eng-36)
(DE86-007573; LA-10625-MS) Avail: NTIS HC A02/MF A01

The development of low-thrust propulsion systems to complement chemical propulsion systems will greatly enhance the evolution of future space programs. Two advantages of low-thrust rockets are stressed. First, in a strong gravitational field, such as occurs near the Earth, freighter missions with low-thrust engines require one-tenth as much propellant as do chemical engines. Second, in a weak gravitational field, such as occurs in the region between Venus and Mars, low-thrust rockets are faster than chemical rockets with comparable propellant mass. The purpose here is to address the physics of low-thrust trajectories and to interpret the results with two simple models. Analytic analyses are used where possible - otherwise, the results of numerical calculations are presented in graphs. DOE

N86-30786# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France).
INCREASING USE OF COMPOSITE STRUCTURE ON ARIANE LAUNCHERS
F. Perez and P. Eymard (Centre National d'Etudes Spatiales, Paris, France) *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 239-244 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30787# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Space Div.
DEVELOPMENT OF THE ARIANE 4 INTERSTAGE 2-3 IN CFRP
C. Blaas *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 245-249 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30788# British Aerospace Dynamics Group, Stevenage (England). Space and Communications Div.
THE DEVELOPMENT OF THE ARIANE 4 SPELDA
N. G. Thomas and W. T. Oliver *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 251-263 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30790# British Aerospace Dynamics Group, Bristol (England). Space and Communications Div.
DESIGN AND DEVELOPMENT TESTING OF THE BONDED JOINT BETWEEN A TYPICAL LAUNCH VEHICLE ATTACHMENT RING AND CFRP THRUST CONE
J. T. Sharkey, G. H. F. Nayler, and J. Reynolds *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 275-284 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation.*

N86-30755*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OBSERVATIONS OF THE EARTH'S MAGNETIC FIELD FROM THE SHUTTLE: USING THE SPARTAN CARRIER AS A MAGNETIC SURVEY TOOL
W. J. Webster, Jr. Jul. 1986 39 p
(NASA-TM-87796; NAS 1.15:87796) Avail: NTIS HC A03/MF A01 CSCL 08B

The shuttle-deployed and recovered Spartan shows promise as an inexpensive and simple support module for potential field measurements. The results of a preliminary engineering study on the applications of the Spartan carrier to magnetic measurements shows: (1) Extension of the mission duration to as long as 7 days is feasible but requires more reconfiguration of the internal systems; (2) On-board recording of Global Positioning System signals will provide position determination with an accuracy consistent with the most severe requirements; and (3) Making Spartan a magnetically clean spacecraft is straight forward but requires labor-intensive modifications to both the data and power systems. As a magnetic survey tool, Spartan would allow surveys at regularly spaced intervals and could make quick-reaction surveys at times of instability in the secular variation. Author

N86-30756*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LATERAL STABILITY AND CONTROL DERIVATIVES EXTRACTED FROM FIVE EARLY FLIGHTS OF THE SPACE SHUTTLE COLUMBIA
James R. Schiess Aug. 1986 34 p
(NASA-TM-88994; NAS 1.15:88994) Avail: NTIS HC A03/MF A01 CSCL 22B

Flight data taken from the first five flights (STS-2, 3, 4, 5 and 9) of the Space Transportation System Shuttle Columbia during entry are analyzed to determine the Shuttle lateral aerodynamic characteristics. Maximum likelihood estimation is applied to data derived from accelerometer and rate gyro measurements and trajectory, meteorological and control surface data to estimate lateral-directional stability and control derivatives. The estimated parameters are compared across the five flights and to preflight predicted values. Author

N86-30689# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
SIGNIFICANCE AND RELIABILITY OF DYNAMIC ANALYSIS METHODS DEMONSTRATED IN THE INSTRUMENT POINTING SYSTEM PROJECT
E. Hilbrandt and J. Kroeker *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 697-699 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications.*

N86-30757# Range Commanders Council, White Sands Missile Range, N. Mex. Telemetry Group.
DIRECTORY OF TRANSDUCER USERS, SEVENTH EDITION
Mar. 1986 72 p Supersedes RCC-100-83

(AD-A167162; RCC-100-86; RCC-100-83) Avail: NTIS HC A04/MF A01 CSCL 09/6

The Directory of Transducer Users is a compilation of knowledgeable transducer personnel at various government activities, aerospace contractors and universities. The Directory has been published to promote the exchange of information between transducer users with common problems. The requirement for the first edition (1973) of this publication was generated at the 7th Transducer Workshop, which was hosted at Albuquerque, N.M., during April 1972 by the Transducer Committee, Telemetry Group, Range Commanders Council. The workshop concluded that a major problem existed in the lack of information-exchange between transducer users. The seventh edition of the Directory of Transducer Users was generated following the 13th Transducer Workshop conducted at Monterey, Cal., in Jun 1985. An index of types of transducers has been included in this edition so that organizations and individuals associated with specific types of transducers can be easily identified. GRA

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics.*

N86-30758# European Space Agency, Paris (France).
PROCEEDINGS OF A WORKSHOP ON COMPOSITES DESIGN FOR SPACE APPLICATIONS
W. R. Burke, comp. Feb. 1986 375 p Workshop held in Noordwijk, Netherlands, 15-18 Oct. 1985
(ESA-SP-243; ISSN-0379-6566; ESA-86-97217) Avail: NTIS HC A16/MF A01

The choice and characteristics of composite materials for space applications, calculation and design methods, and dimensional stability were some areas of discussion in this workshop. Also discussed was integrity control, Ariane applications of composites, load carrying structures in satellites, and satellite antenna and solar array applications. For individual titles, see N86-30759 through N86-30799.

N86-30759# Fulmer Research Inst. Ltd., Stoke Poges (England).
THE APPLICATION OF COMPOSITES TO SPACE STRUCTURES: GUIDELINES ON IMPORTANT ASPECTS FOR THE DESIGNER
D. P. Bashford *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 9-16 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

Guidelines and surveys on the state of composites as structural aerospace materials were produced. The guidelines give a detailed background on composites for spacecraft and are intended for designers and engineers unfamiliar with composites. Topics covered include: selection of composite materials; aramid composites; prepreg and resin procurement specifications; nondestructive tests polymeric matrices; mechanical test methods for composites; joining techniques; and moisture absorption/thermal cycling response. ESA

N86-30760# Salford Univ. (England). Dept. of Pure and Applied Physics.
HYGROTHERMAL CHARACTERISTICS OF ANTENNA MATERIALS
J. W. Atkinson, G. H. Wostenholm, and B. Yates *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 17-24 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

Increases in mass resulting from the absorption of water by epoxy resins reinforced with Kevlar 49 and Nomex fibers are reported. The influence of relative humidity over the range 12% to 93% at 23 C was studied, along with the effects of fiber volume fraction and fiber type on the final moisture content of the systems. High volume fraction materials absorb less than low volume fraction materials. Nomex absorbs more moisture than Kevlar. The modified Boltzmann transport model proposed by Carter and Kibler (1978) gives a better description of the behavior than the classical Fickian model proposed by Shen and Springer (1976). Absorption from atmospheres at low humidities appears to be governed by different laws from those operating at intermediate and high humidities. ESA

N86-30761# National Engineering Lab., East Kilbride (Scotland).
FATIGUE AND DAMAGE IN FIBRE REINFORCED NYLON c24
W. S. Carswell *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 25-29 Sponsored by UK Dept. of Trade and Industry (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

Fatigue tests with a range of mean loads and at two temperatures were carried out on short glass-fiber nylon and short graphite-fiber reinforced nylon. Changes were monitored by noting the peak deflection. Range of deflections and the peak deflection increase, indicating a rotation of the hysteresis loop and creep in the direction of maximum load. The range of deflections at room temperature and at elevated temperature indicates endurance, although there are differences in performance at elevated temperature. The extent of such changes necessary for failure is obscure. ESA

N86-30762# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THERMAL RESIDUAL STRESSES IN SYMMETRIC AND UNSYMMETRIC CARBON FIBER REINFORCED PLASTICS: SOME TENTATIVE WAYS OF EVALUATION c39
J. P. Favre *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 31-38 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

Effects of thermal stresses which develop during fabrication on the integrity of composites used in spacecraft are discussed. For an unsymmetric material, the result is a modification of the shape. In the simple case of a long and thin cross-ply specimen, residual stresses in the transverse plies can be deduced from reading the curvature. For a plate, the existence of several stable shapes according to the aspect ratio is verified. For the symmetric material, in-situ estimation of residual stress magnitude by X-ray diffraction using a metallic powder embedded between the plies is described. ESA

N86-30763# Atomic Energy Research Establishment, Harwell (England). Materials Development Div.
DYNAMIC MECHANICAL ANALYSIS AS AN AID TO THE CHARACTERIZATION OF COMPOSITE MATERIALS c24
D. H. Bowen, R. Davidson, R. J. Lee, and M. Aguirre *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 39-46 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

Dynamic mechanical analysis (DMA) was used to assess the thermal properties of polymeric materials and resin matrix carbon fiber composites. By considering the storage and loss moduli and damping as a function of temperature, information relating to the nature, state of cure, and hysteretic characteristics of the matrix can be obtained. This information assists in the interpretation of the impact strengths and creep resistance of polymers and composites. Examples of the use of DMA in research and development programs with composite materials based on heat resistant thermoplastic (PES, PEI, PEEK) and thermosetting polymers (phenolics, bismaleimides and epoxides) are given. The factors and limitations affecting the quantitative stiffness measurements of orthotropic composite materials by DMA are discussed,

specifically measurements on unidirectional carbon fiber reinforced polyether ether ketone. ESA

N86-30764# Southampton Univ. (England). Inst. of Sound and Vibration Damping.
DAMPING OF COMPOSITES **c39**
T. A. Willway *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 47-52 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

Methods of predicting the damping characteristics of composite materials and the effects of various parameters on that damping are reviewed. Experimentally determined values of the damping of composite materials are given. ESA

N86-30765# Imperial Coll. of Science and Technology, London (England). Center for Composite Materials.
THE STRENGTH OF BOLTED JOINTS IN KEVLAR RP **c39**
J. M. Hodgkinson, D. L. deBeer, and F. L. Matthews *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 53-61 Sponsored by ESA (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

Failure data for single and multibolt joints in woven Kevlar reinforced epoxy resin are presented. The results are relevant to 6-ply, 0.5 mm thick, symmetrical laminates of different fiber orientation. Bolts used were M4 diameter (d) with standard washers. Lay-up, bolt tensile load, and hence washer pressure, end (e) and width (w) effects were explored in single and double lap joint configurations. Quasi-isotropic lay-ups fail at higher stresses than orthotropic laminates, and, for sufficiently large e/d and w/d ratios, failure is in bearing with no observable edge effects. Multiple bolt tests concerned lines and rows of bolts, the pitch being varied to determine the effects of bolt interaction. These tests were performed on the preferred quasi-isotropic lay-up. ESA

N86-30766# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
ORTHOTROPIC PROPERTIES OF LAYERED FIBER COMPOSITES **c24**
G. R. Kress *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 65-70 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

A mathematical method to replace orthotropic and symmetric laminates by a homogeneous material whose mechanical properties are defined in all three spatial directions is presented. A very good agreement between the out-of-plane properties calculated with the method and those obtained using a finite element approach is shown. The values for the in-plane properties are identical to those obtained by the classical lamination theory. ESA

N86-30767# Waldrich Siegen Werkzeugmaschinen G.m.b.H., Burbach (West Germany).
THEORETICAL AND EXPERIMENTAL BEHAVIOR OF CARBON FIBER REINFORCED PLASTICS UNDER MECHANICAL AND THERMAL LOAD **c24**
U. Bieling *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 71-78 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

Based on a fiber resin system for aerospace components, the linear and nonlinear stress-strain behavior of CRP laminates is investigated. Theoretical and experimental results correlate very well up to high loads by entering strain-dependent coefficients into the stiffness matrix. Approaches for tracking the initiation of microcracks and crack propagation by acoustic emission and dissipation of energy are presented. By measuring the coefficients of thermal expansion (CTE) of a basic lamina and the equations of classical lamination theory, CTE's of any laminate can be calculated. ESA

N86-30768# Politecnico di Milano (Italy). Dept. of Aerospace Engineering.
ANALYTICAL AND EXPERIMENTAL RESULTS OF ADVANCED COMPOSITE STIFFENED PANELS UNDER COMBINED LOADS **c39**
Giulio Romeo *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 79-86 Sponsored by Italian Ministry of Education (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

A theoretical analysis to design advanced composite hat and blade-stiffened panels under uni and biaxial compression and/or shear is reported. The analysis is based on the buckling equation of the simply-supported orthotropic plate to predict the overall buckling of the panel and the local buckling of each cross-section element, and on the torsional instability theory for the blade-stiffened panels. A computer program to evaluate the minimum-mass optimization of the panels was designed. Tests on graphite/epoxy hat and blade-stiffened panels under uniaxial compression and unstiffened panels under shear were conducted. Adequate correlation between theoretical analysis and experimental results is obtained. ESA

N86-30769# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost.
HAND CALCULATION METHOD FOR BUCKLING OF COMPOSITE SHELL STRUCTURES **c39**
R. F. P. vanZelst *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 87-93 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

The buckling load of a simply supported composite shell structure is determined. The laminate properties including the transverse shear properties are derived from the classical laminate theory. From the general buckling equation the panel buckling allowable and the local buckling allowable of several types of cross sections are derived. The equations are put into a small FORTRAN program. Results for an undisturbed shell structure are in good agreement with the results from the finite difference program BOSOR 4. ESA

N86-30770# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Space Div.
ADEQUATE FIBER REINFORCED STRUCTURAL ELEMENTS IN LOAD INTRODUCTION AREA OF FIBER REINFORCED SHELLS **c39**
F. S. D. Rekers *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 95-99 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

Design of reinforcements around access holes and near cylinder ends in structural shells is discussed. Elements necessary for introduction of axial-load and bending moment in a cylinder are presented. Monolithical behavior; hoop stiffness; torsional stiffness; shear stiffness; and shear introduction were implemented in three different shell-configurations. ESA

N86-30771# Brussels Univ. (Belgium).
NEW PREDICTION METHODS FOR COMPOSITES HYGROTHERMAL BEHAVIOR **c24**
C. C. Hiel *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 101-107 Sponsored by NAS-NRC and NATO (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

A method to predict the thermal expansion and swelling of a composite material due to temperature and moisture variations which typically occur in a launch environment is presented. It is demonstrated that constitutive equations for moisture absorption and moisture-induced dimensional changes can be obtained with an internal variable method rooted in the theory of irreversible thermodynamics. Realism is injected into the model through the concept of free volume. ESA

N86-30772# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).
DESIGN AND MANUFACTURING ASPECTS OF SPACE TRUSSES
H. W. Bergmann *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 109-115 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

The dimensional stability of fiber reinforced composites for large space structure trusses is discussed. Temperature and moisture effects cannot be accurately assessed by extrapolation from the response of small test coupons. The buckling strength of hollow filament-wound struts depends very sensitively on the angular directions of the individual plies. Optimal configurations can be derived by a computerized program. An alternative approach to filament-wound strut construction by surrounding a prefabricated foam core by carbon fiber rovings or fabrics is viable. The interconnection of struts in rigid three-dimensional trusses is possible by filament-wound joints with the advantages of low cost, low weight, and improved thermal compatibility. ESA

N86-30773# Construcciones Aeronauticas S.A., Madrid (Spain). Space and Systems Div.
HIGH-STABILITY TELESCOPE STRUCTURES **c89**
G. Galipienso and S. DellAmico *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 119-132 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

A methodology for the design of structures requiring a high degree of dimensional stability, of the Space Telescope/GRIST type, was derived. The optimum structural configuration and the optimum laminate lay-up compatible with the structural strength and stiffness requirements were determined. The global behavior of the complete structure as a function of less-than-ideal component properties was established. Levels of maximum allowable deviations for real properties of components belonging to different families were determined. A method for adjustment of the coefficient of thermal expansion after manufacturing to compensate for unavoidable deviations in component properties was devised. A test method allowing measurement of very small distortions was developed. ESA

N86-30774# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Aeronautical Structures and Materials.
THERMAL STABILITY OF SANDWICH REFLECTORS **c24**
H. Groth *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 133-139 Sponsored by Ericsson Radio System (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

The inplane coefficient of thermal expansion (CTE) of the honeycomb sandwich of a spacecraft antenna reflector was treated using an analytical model, where the panel is treated like a sandwich panel, and an approach using the finite element method. Both methods are based on linear elasticity. For the first model the influence of different sandwich parameters is discussed. For the second model, the CTE is calculated for a typical panel, and results are compared with the first model. A difference between the two models is explained by the behavior of the honeycomb core. In the analytical model the core and the faces are assumed to keep their initial shape, i.e., no bending or out of plane deformations of the honeycomb cell walls or of the faces. The analytical model may therefore serve as an upper bound solution of the thermal expansion of the panel. ESA

N86-30775# European Space Agency, Paris (France). Mechanical Systems Div.
DIMENSIONAL STABILITY OF CFRP TUBES FOR SPACE STRUCTURES
G. G. Reibaldi *In its* Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 141-147 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

Dimensional stability of CFRP tubes used in spacecraft structures was investigated as a function of the number of thermal cycles. Length and weight decrease with the number of cycles. Thermal cycling generates microcracking, which increases desorption rate for the weight and length. For the SPAS tube T006 the length increases with respect to the initial value, probably due to large microcracking. The polythene bag does not influence the absorption rate. No clear asymptotic value for the weight and length variation with the increasing of thermal cycles is found. Permanent deformations are expected in orbit, about 25 microns after 300 thermal cycles. Lay-up of the CFRP tube is important for dimensional stability. A CIBA-GEIGY tube shows lower length variation, even if the weight loss is similar to that of the SPAS. ESA

N86-30776# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
HOLOGRAPHIC INTERFEROMETRY FOR DISTORTION MEASUREMENTS OF ANTENNAS **c35**
H. U. Frey *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 149-155 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

Holographic interferometry was developed and adapted to a space environment simulation chamber. The test method is described and test results of antenna dishes from 1.2 to 3.6 m diameter are presented. ESA

N86-30777# California Univ., Berkeley. Dept. of Mechanical Engineering and Center for Advanced Materials.
DELAMINATION FRACTURE TOUGHNESS OF COMPOSITE SPACECRAFT STRUCTURES
C. K. H. Dharan *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 159-167 (For primary document see N86-30758 22-18)
(Contract DE-AC03-76SF-00098)
Avail: NTIS HC A16/MF A01

Opening mode (mode 1) delamination fracture behavior of graphite and aramid-epoxy composites was investigated. The effect of loading rate and reinforcement geometry (unidirectional vs woven) on fracture toughness was determined, and observation of the fracture surface was used to derive microfailure modes. A micromechanical delamination model to estimate the relative contributions of the matrix and the fiber-matrix interface to the overall delamination fracture toughness is proposed. Results show that the mode 1 delamination fracture toughness of graphite composites is small relative to glass composites. Woven graphite composites exhibit opening mode delamination crack energy release rates 2.5 times those of the unidirectionally reinforced material. The fracture surface of the graphite-epoxy laminates is characterized by clean exposed fiber surfaces indicating poor interfacial fracture toughness. ESA

N86-30778# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Aeronautical Structures and Materials.
DAMAGE ZONE FRACTURE ANALYSIS OF FIBROUS COMPOSITES **c39**
Kaj Hollmann, Per Clarin, C.-G. Aronsson, and Jan. Baecklund *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 169-174 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

Excellent results were achieved using the Damage Zone Model (DZM) to predict mode 1 fracture loads of notched composites. A computer program of high computational efficiency, called FRACOM, was developed. Computations are performed in a few minutes on a personal computer and result in an estimated load-displacement behavior and damage zone characteristics under quasi-static loading. ESA

N86-30779# Engineering System International, Rungis (France).
INDUSTRIAL CALCULATION OF DAMAGE TOLERANCE AND STRESS ALLOWABLES IN COMPONENTS MADE OF COM-

POSITE MATERIALS USING THE PAM-FISS/BIPHASE MATERIAL MODEL c39

A. deRouvray and E. Haug *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 175-185 Sponsored by ESA/ESTEC (For primary document see N86-30758 22-18)

Avail: NTIS HC A16/MF A01

A finite element code to simulate the heterogeneous constitution of composite materials during the damage process was developed. The code simulates the basic damage mechanisms; matrix micro and macrocracking, fiber ruptures, layer delamination. It is used to calculate initial, tangent, and residual rheological properties, as well as damage (or defect) initiation and stable/unstable growth, in the critical zones of arbitrary composite structures. It provides realistic equivalent homogeneous properties (moduli; stress/strain allowables) compatible with an efficient damage tolerant design. ESA

N86-30780# Paderborn Univ. (West Germany). Fachgebeit Technische Mechanik.

ON CORRELATION BETWEEN THERMAL STRESSES, ELASTIC STRAIN ENERGY AND DEBONDING IN THERMALLY LOADED FIBER-REINFORCED COMPOSITE MATERIALS c39

F.-G. Buchholz *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 187-196 (For primary document see N86-30758 22-18)

Avail: NTIS HC A16/MF A01

Correlations between thermal stresses, elastic strain energy, and the energy release rate during debonding of unidirectionally fiber reinforced composite materials are investigated numerically. It is shown that the strain energy caused by thermal loads in a single circular unit cell of such a material is directly correlated with the energy spent by the compound on debonding of fiber and matrix. For a corresponding hexagonal unit cell within a compound two additional influences are effective, resulting in an interferred correlation and distinctly lower energy release rates during the process of debonding. ESA

N86-30781# Strathclyde Univ., Glasgow (Scotland). Dept. of Mechanics of Materials.

ASSESSING THE EFFECTS OF DELAMINATIONS ON THE POSTBUCKLING STRENGTH OF CRFP PANELS c39

W. M. Banks, J. Rhodes, and G. B. Chai *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 197-202 Sponsored by UK Ministry of Defense and ESA (For primary document see N86-30758 22-18)

Avail: NTIS HC A16/MF A01

The effect of deliberately inbuilt delaminations on the post-buckling strength of carbon fiber composite panels with a b/t ratio of 70 and 50 was tested. The panels are fabricated from 14 layers of unidirectional carbon fiber using an autoclave process. The delamination positions were chosen to coincide with the position of highest interlaminar shear stress, the position of highest direct strain, the central buckle peak, and the inflection points on the panel. The control panel for a b/t ratio of 68.57 failed prematurely due to unforeseen edge effects. However it is clear that the worst position for delamination is when it coincides with the highest interlaminar shear stress at the edge of the panel. There appears to be little effect with the delamination at the buckle peak. ESA

N86-30782# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).

ON THE DEFECT SENSITIVITY OF SPACECRAFT TYPICAL THIN CFRP LAMINATES c24

J. Bischoff *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 203-209 (For primary document see N86-30758 22-18)

Avail: NTIS HC A16/MF A01

The brittleness of high modulus CFRP laminates used in spacecraft was investigated. It is shown that small defects can cause a crucial reduction of loading capacity. The dependence of this reduction on fiber orientation and the laminate stacking sequence is discussed. Fiber-matrix-bonding is identified as an essential factor affecting the notch sensitivity. ESA

N86-30783# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).

INTEGRITY OF CARBON FIBER REINFORCED PLASTICS. STRUCTURAL ELEMENTS, SCREENING PROCEDURES, OPPORTUNITIES AND OPEN ISSUES c24

Werner H. Paul *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 211-215 (For primary document see N86-30758 22-18)

Avail: NTIS HC A16/MF A01

Activities (of the standard design procedure) necessary to prevent catastrophic failures of CFRP manufactured items in manned spaceflight due to global or local deficiencies are discussed. Criteria which CFRP structural elements must meet in order to be used in STS are given. ESA

N86-30784# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).

NONDESTRUCTIVE TESTING OF FIBER REINFORCED COMPOSITES USING X-RAY FINE STRUCTURE PROCEDURES c38

J. Walter and Henschel (Bundesanstalt fuer Materialpruefung, Berlin, West Germany) *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 217-229 (For primary document see N86-30758 22-18)

Avail: NTIS HC A16/MF A01

Nondestructive inspection (NDI) of fiber reinforced composites is introduced. Nondestructive testing with the X-ray fine structure procedure is based on the fact that the paracrystalline microstructure of the fibers diffracts the X-rays at the lattice planes. The long chain molecules are arranged in a nearly crystalline (paracrystalline) configuration; the chains have a high degree of orientation parallel to the fiber axis, so that the X-ray pattern produced by a bundle of fibers irradiated in a directional normal to their long axis is typical for the specific type. This property can be used as NDI-criterion and thickness layer measurement method. ESA

N86-30785# Fulmer Research Inst. Ltd., Stoke Poges (England).

DEVELOPMENTS IN THE NONDESTRUCTIVE EVALUATION (NDE) OF COMPOSITE MATERIALS c38

R. L. Crocker *In its* Proceedings of a Workshop on Composites Design for Space Applications (ESA-SP-243) Feb. 1986 p 231-235 (For primary document see N86-30758 22-18)

Avail: NTIS HC A16/MF A01

The effects on composites inspection of digital techniques of computing and data storage, robotics, and image processing made possible by digitizing raw data are assessed. Ultrasonics, X-radiography, thermography, mechanical impedance, vibrothermography, and laser holography are discussed. In many cases the actual defect detection capability is not changed by introducing these techniques, it is the integrity of the inspection or evaluation which is improved. ESA

N86-30786# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France).

INCREASING USE OF COMPOSITE STRUCTURE ON ARIANE LAUNCHERS c15

F. Perez and P. Eymard (Centre National d'Etudes Spatiales, Paris, France) *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 239-244 (For primary document see N86-30758 22-18)

Avail: NTIS HC A16/MF A01

The progressive use of composite structures on Ariane launchers 1 to 4 generation and the tendency for Ariane 5 is outlined. Carbon fiber and glass fiber reinforced plastics are involved. Mass saving, rigidity requirements, and cost arguments are mentioned. Rupture criteria, orthotropic effects, thermal effects and quality control are discussed. ESA

N86-30787# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Space Div.

DEVELOPMENT OF THE ARIANE 4 INTERSTAGE 2-3 IN CFRP **c15**

C. Blaas *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 245-249 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

For the Ariane 4 interstage 2/3, stiffened skin panels of CFRP were developed. The panels are 1.0 m wide and 2.7 m long. Each panel has 15 blade-type stiffeners with a height of 25 mm on a pitch of 68 mm. The material used is Fiberite 976-T300 in laying sequences of 45 and 0 deg. The total mass reduction of the structure compared to the aluminum version is greater than 20%. In the design of the structure, classical laminate theory and the numerical programs BOSOR 4, NASTRAN and SINDA were used. ESA

N86-30788# British Aerospace Dynamics Group, Stevenage (England). Space and Communications Div.
THE DEVELOPMENT OF THE ARIANE 4 SPELDA **c15**

N. G. Thomas and W. T. Oliver *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 251-263 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

Structural design of the load carrying external structure used as Ariane upper payload support and lower payload protector, the so-called SPELDA, is outlined. Major design drivers for SPELDA were mass, stiffness, and strength. A CFRP faced honeycomb sandwich was adopted. The models, test methods, design steps, and manufacturing and analysis problems are summarized. ESA

N86-30789# National Space Development Agency, Tokyo (Japan).
DESIGN AND DEVELOPMENT OF THE GRAPHITE EPOXY STRUCTURE FOR CS-3 SATELLITE

Tsuneo Kawashima, Toshio Inoue (Mitsubishi Electric Corp., Kanagawa, Japan), and Hiromi Seko *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 267-274 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

The CS-3 satellite design requirements, internal load analysis of the structural members, laminate design of CFRP components, sheet/core design of equipment panels, configurations of the structural members, development tests, of the structural thermal model, and the results of weight reductions are described. Designs that attain the minimum weight were performed for main structures such as the thrust tube and the equipment panels. Weight reductions of the secondary structures such as joints, brackets and end fittings of struts greatly contribute to the weight reduction of the structure. The structure weighs 53 kg, i.e., 4.9% of the 1088 kg launch weight. ESA

N86-30790# British Aerospace Dynamics Group, Bristol (England). Space and Communications Div.
DESIGN AND DEVELOPMENT TESTING OF THE BONDED JOINT BETWEEN A TYPICAL LAUNCH VEHICLE ATTACHMENT RING AND CFRP THRUST CONE **c15**

J. T. Sharkey, G. H. F. Nayler, and J. Reynolds *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 275-284 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

The development of the principal structural joint of a Shuttle payload is described. The joint is subjected to large tension and compression loads due to the spacecraft being cantilevered perpendicular to the direction of flight of the launch vehicle. Finite element modeling was included in the investigation of joint designs. A bonded and bolted double lap shear configuration was chosen. Manufacturing and inspection methods were developed and testing of joint samples was undertaken including static, thermal and fatigue loading. The static test results were used to determine the design allowable strength of the joint. ESA

N86-30791# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
ON THE DEVELOPMENT OF A CORRUGATED CFRP CENTRAL CYLINDER FOR SATELLITES

D. Brosda *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 285-290 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

Development of a corrugated central cylinder for satellites in the DFS-class, including design, analyses, manufacture, assembly and tests is summarized. The central cylinder has a mean diameter of 938 mm and a length of 1780 mm. The cylinder wall consists of a corrugated CFRP shell of variable thickness. Three CFRP rings provide for the attachment of antenna, equipment, and payload platforms. The thrust cylinder is designed to meet the standard frequency requirements (less than 15 Hz lateral and less than 35 Hz axial) and carry the loads associated with a typical satellite mass of 1400 kg whose CG position lies 1000 mm above the separation plane. The first flight structure to be equipped with the cylinder is the German communication satellite DFS Kopernikus. ESA

N86-30792# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France).
COMPARISON OF CLASSICAL AND COCURING MANUFACTURING TECHNIQUES FOR A CFRP HONEYCOMB CENTRAL TUBE **c31**

J. L. Pettex *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 291-294 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

Classical and cocuring manufacturing of a sandwich structure using CFRP skins and an aluminum alloy honeycomb core for the Arabsat central tube are compared. The cocuring technology leads to a simplification of the manufacturing and consequently to a cost reduction. ESA

N86-30793# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (West Germany).
FIBER REINFORCED PLASTIC CASES FOR SOLID PROPELLANT MOTORS **c20**

H. Krings and J. Scharringhausen *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 295-299 Sponsored by ESA, BMFT, DFVLR and CNR (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

The design, fabrication, and tests performed for the FRP-cases for solid propellant motors of MAGE apogee boost motors are described. Definition of launcher and satellite requirements, and qualification of the motor are presented. ESA

N86-30794# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
STRENGTH OF CARBON FIBER COMPOSITE/TITANIUM BONDED JOINTS AS USED FOR SPAS-TYPE STRUCTURES

J. Franz and H. Laube *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 301-308 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

The analytical and experimental verification of bonded tubes used for SPAS strut assemblies is described. The strut elements consist of a carbon fiber tube and two titanium mounting elements, connected by tapered, double-shear bonded joints. The analysis of the geometric design minimized the shear stress peaks at the ends of the overlapping section under external and temperature loadings. The load capability is verified by a destructive qualification test program (static load and fatigue) and each individual strut is acceptance tested before integration into a satellite structure. Data can be used for load capability estimations for similar strut components, i.e., with increased or decreased tube diameter, or with modified overlapping length of the bonding section. ESA

N86-30795# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (West Germany). Neue Technologie.
MANUFACTURING TECHNOLOGY OF GRAZING-INCIDENCE MIRROR CARRIERS MADE OF CARBON FIBER REINFORCED

EPOXY MATRIX SYSTEMS c89
J. Klug *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 311-318 Sponsored by ESA (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

Manufacturing techniques for the low energy telescopes for the X-ray Multi Mirror mission were studied. X-ray parabolic mirror carriers onto which the reflecting X-ray surface was transferred by the replica method as developed for EXOSAT were fabricated. Instead of using beryllium carriers, the use of carbon fiber reinforced epoxy carriers was investigated, for the series production envisaged for XMM. Carrier design and manufacturing, carrier characteristics obtained, critical areas encountered during the feasibility study, and future activities are discussed. ESA

N86-30796# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Space Div.
DESIGN AND DEVELOPMENT OF THE ADVANCED RIGID ARRAY (ARA) SOLAR PANEL c44
R. W. H. Horsselenberg *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 319-328 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

The Advanced Rigid Array panel technologies are summarized: specific weight is less than 1.2 kg/sqm; can survive extreme thermal cycling (plus 80 to minus 180 C); excellent flatness and dimensional stability; extremely high stiffness properties due to application of GY-70 carbon fiber; high satellite interface flexibility; high panel sizing flexibility; and simple and low cost production. Developments include the establishment of panel technologies to obtain specific weights below 0.8 kg/sqm via open lay-up CFRP facesheet technology. ESA

N86-30797# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
DEVELOPMENT OF AN ANTENNA STRUCTURE FOR A DEPLOYABLE OFFSET ANTENNA c32
H. Herbig, W. Tauber, and H. Vorbrugg *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 329-336 (For primary document see N86-30758 22-18)
(Contract ESTEC-5206/82-NL-PB(S6))
Avail: NTIS HC A16/MF A01

An unfurlable spacecraft antenna is described. The antenna consists of a central hub, ribs being radially arranged around the hub, and a mesh which produces the parabolic reflector surface shape. The hub and the ribs are made of CFRP. For the stowed and deployed reflector configuration the CFRP-components were analyzed and optimized under dynamical and dimensional stability aspects. The analytical results and the development of the CFRP components are presented. ESA

N86-30798# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
STRUCTURAL ANALYSIS, MANUFACTURING AND TEST EVALUATION OF A POLARIZATION SENSITIVE REFLECTOR c32
W. Weiss, K. Pfeifer, and R. Leitner *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 337-347 (For primary document see N86-30758 22-18)
(Contract ESTEC-5494/84-NL(CM))
Avail: NTIS HC A16/MF A01

A parabolic reflector for space applications was developed. The reflector consists of two Kevlar/Nomex sandwich shells with a diameter of 1100 mm. Their edges are connected by a Kevlar/glass ring. The rear shell is fixed to the satellite by a conical carbon fiber composite cylinder and stiffened by four Kevlar/Nomex ribs. To minimize the thermal stresses the thermal expansion coefficients were adjusted to the reflector shells. In the static analysis a finite element calculation was performed for an acceleration of 15 g and for the most critical Sun irradiation with a partly shadowed reflector. All stresses are below the strength limits. The antenna was tested by sine vibration, acoustic noise, thermal cycling, and solar simulation without failure. ESA

N86-30799# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
A STEP TOWARDS AN ESA COMPOSITES DESIGN HANDBOOK FOR SPACE STRUCTURE APPLICATIONS
J. Bolz *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 351-355 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

The European Space Agency initiated a Composites Design Handbook for Space Structure Applications, because the increasing application of composite materials in space structures requires harmonization. Establishment of a Handbook structure and the compilation of information on as many topics as possible is described. ESA

N86-30800*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
APPLICATION OF THE LQG/LTR TECHNIQUE TO ROBUST CONTROLLER SYNTHESIS FOR A LARGE FLEXIBLE SPACE ANTENNA
Suresh M. Joshi, Ernest S. Armstrong, and N. Sundararajan (Old Dominion Univ., Norfolk, Va.) Sep. 1986 64 p
(NASA-TP-2560; L-16076; NAS 1.60:2560) Avail: NTIS HC A04/MF A01 CSCL 22B

The problem of synthesizing a robust controller is considered for a large, flexible space-based antenna by using the linear-quadratic-Gaussian (LQG)/loop transfer recovery (LTR) method. The study is based on a finite-element model of the 122-m hoop/column antenna, which consists of three rigid-body rotational modes and the first 10 elastic modes. A robust compensator design for achieving the required performance bandwidth in the presence of modeling uncertainties is obtained using the LQG/LTR method for loop-shaping in the frequency domain. Different sensor actuator locations are analyzed in terms of the pole/zero locations of the multivariable systems and possible best locations are indicated. The computations are performed by using the LQG design package ORACLS augmented with frequency domain singular value analysis software. Author

N86-30801*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECTS OF MODEL ERROR ON CONTROL OF LARGE FLEXIBLE SPACE ANTENNA WITH COMPARISONS OF DECOUPLED AND LINEAR QUADRATIC REGULATOR CONTROL PROCEDURES
Harold A. Hamer and Katherine G. Johnson Sep. 1986 52 p
(NASA-TP-2604; L-16114; NAS 1.60:2604) Avail: NTIS HC A04/MF A01 CSCL 22B

An analysis was performed to determine the effects of model error on the control of a large flexible space antenna. Control was achieved by employing two three-axis control-moment gyros (CMG's) located on the antenna column. State variables were estimated by including an observer in the control loop that used attitude and attitude-rate sensors on the column. Errors were assumed to exist in the individual model parameters: modal frequency, modal damping, mode slope (control-influence coefficients), and moment of inertia. Their effects on control-system performance were analyzed either for (1) nulling initial disturbances in the rigid-body modes, or (2) nulling initial disturbances in the first three flexible modes. The study includes the effects on stability, time to null, and control requirements (defined as maximum torque and total momentum), as well as on the accuracy of obtaining initial estimates of the disturbances. The effects on the transients of the undisturbed modes are also included. The results, which are compared for decoupled and linear quadratic regulator (LQR) control procedures, are shown in tabular form, parametric plots, and as sample time histories of modal-amplitude and control responses. Results of the analysis showed that the effects of model errors on the control-system performance were generally comparable for both control procedures. The effect of mode-slope error was the most serious of all model errors. Author

N86-30802# Tri-Con Associates, Inc., Cambridge, Mass.
DESIGN, FABRICATE AND TEST SPACECRAFT AUTOMATIC ACTIVE DISCHARGE SYSTEM (SAADS) Final Report, 20 Jul. 1983 - 15 Jun. 1985
Robert S. Hills 25 Sep. 1985 18 p
(Contract F19628-83-C-0153)
(AD-A166559; C-214; AFGL-TR-85-0236) Avail: NTIS HC A02/MF A01 CSCL 22/2

The objective of this contract is the design, fabrication, and testing of a Spacecraft Automatic Active Discharge System (SAADS) which will attempt to automatically control and dissipate the vehicle charge as a function of natural or induced disturbances in space. A microprocessor based controller will monitor and manipulate data from a Proton Electrostatic Analyzer (ESA) to determine if the vehicle charge is greater than a predetermined value and then activate a Plasma Source to discharge the vehicle. The plasma source short circuits the charge. This equipment is to be flown as part of the BERT I payload to demonstrate the feasibility of the system for eventual use in a satellite in a true space environment. GRA

N86-30803# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
CONTROL OF LARGE FLEXIBLE SYSTEMS BY SPATIAL MODAL INPUT-DISTRIBUTION CONTROL M.S. Thesis
Craig V. Bendorf 1985 113 p
(AD-A166912; AFIT/CI/NR-86-47T) Avail: NTIS HC A06/MF A01 CSCL 22/2

A common problem in controlling a large flexible structure with a reduced order model is the excitation of the residual (non-modeled) modes by the control inputs resulting in control spillover. In this thesis a new approach to eliminate control spillover is examined. This approach, based on the independent modal-space control method, uses a finite number of spatially distributed input points to eliminate control spillover. Control of an undamped beam and a finite degree of freedom truss is accomplished through computer simulation. The results of the seven example problems shows that this new approach does effectively eliminate control spillover. GRA

N86-30804# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France).
WINDING WITH THERMOPLASTIC POLYMERS
J. L. Tisne and J. Bouvard 1986 8 p Presented at 3rd European Symposium on Spacecraft Materials in Space Environment, Noordwijk, Netherlands, 3 Oct. 1985 Previously announced as N86-22613
(SNIAS-861-430-106; ESA-86-97168) Avail: NTIS HC A02/MF A01

Filament winding of continuous fibers impregnated with thermoplastic resins for spacecraft structure manufacturing is described. The mandrel is at ambient temperature, or is maintained below the fusion temperature, which enables winding unstable trajectories by means of the under layer/strand sticking. Another method consists in having the material and the mandrel at the fusion temperature while winding. This process simplifies the machine but presents two drawbacks, with respect to the thermoset resins: it is impossible to wind other than stable trajectories, close to geodetic ones; and the curing on the thermoset epoxy (maximum 180 C) is replaced by a fusion in an oven (from 250 to 400 C). This poses a problem of resistance of the enclosed parts and tools. ESA

N86-30805*# Martin Marietta Corp., Denver, Colo.
SPACE STATION AUTOMATION STUDY. VOLUME 1: EXECUTIVE SUMMARY. AUTONOMOUS SYSTEMS AND ASSEMBLY Final Report
Nov. 1984 64 p
(Contract NAS8-35042)
(NASA-CR-176860; NAS 1.26:176860; DE85-902179;
MCR-84-1878-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 22B

The purpose of the Space Station Automation Study (SSAS) was to develop informed technical guidance for NASA personnel in the use of autonomy and autonomous systems to implement space station functions. DOE

N86-30652*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
STIFFNESS CONTROL OF LARGE SPACE STRUCTURES
Jay-Chung Chen and James L. Fanson *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 368-373 Sponsored by NASA (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03 CSCL 01B

N86-30653# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
ASPECTS OF ACTIVE ISOLATION AS APPLIED TO A SATELLITE STRUCTURE WITH SHAPE PRECISION PAYLOAD
W. Charon *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 374-380 (For primary document see N86-30627 22-01)
(Contract ESTEC-5326/83-NL-PB(SC))
Avail: NTIS HC A99/MF E03

N86-30658# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
STRUCTURAL OPTIMIZATION WITH CONSTRAINTS IN DYNAMICS
Horst J. Baier *In* DGLR The 2nd International Symposium on Elasticity and Structural Dynamics 1985 p 426-433 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30672# Spar Aerospace Ltd., Toronto (Ontario).
MODAL PARAMETERS ESTIMATION FROM DRIVEN-BASE TESTS
S. Draisey, F. R. Vigneron (Department of Communications, Ottawa, Ontario), Y. Soucy, and J.-G. Beliveau (Sherbrooke Univ., Quebec) *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 546-552 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30680# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
ANALYSIS-TEST CORRELATION OF DYNAMIC MATHEMATICAL MODELS
B. Caesar *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 617-624 (For primary document see N86-30627 22-01)
(Contract ESTEC-5597/83/NL-PB(SC))
Avail: NTIS HC A99/MF E03

N86-30682*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TEST AND ANALYSIS CORRELATION FOR STRUCTURAL DYNAMIC SYSTEMS
Ben K. Wada and Jay-Chung Chen *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 632-647 Sponsored by NASA (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03 CSCL 01B

N86-30683*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DYNAMIC VERIFICATION OF VERY LARGE SPACE STRUCTURES
Brantley Hanks, R. *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 648-655 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03 CSCL 01B

N86-30684# Technische Hochschule, Aachen (West Germany). Inst. fuer Leichtbau.
RECONSTRUCTION OF FORCING FUNCTIONS BASED ON MEASURED STRUCTURAL RESPONSES

H. Oery, H. Glaser, and D. Holzdeppe *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 656-668 Sponsored by Deutsche Forschungsgemeinschaft, ESA, and MBB/Erno G.m.b.H. (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30685# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
SPACECRAFT STRUCTURES DESIGN AND VERIFICATION
C. Stavrinidis *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 669-671 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30686# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
LOW FREQUENCY DESIGN VERIFICATION OF LARGE SPACECRAFT STRUCTURES
E. Erben and K. Eckhardt *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 672-682 Sponsored by INTELSAT and ESTEC (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30687# Department of Communications, Ottawa (Ontario). David Florida Lab.
VIBRATION QUALIFICATION AT THE DAVID FLORIDA LABORATORY
Rolf Mamen *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 683-688 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30688# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
INFLUENCE OF NONLINEAR SPACECRAFT COMPONENTS ON DYNAMIC LAUNCH AND IN-ORBIT RESPONSE
I. Kolsch and H. Baier *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 689-696 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N86-30806*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Research Lab.
ULTRAVIOLET SPECTROMETER AND POLARIMETER (UVSP) SOFTWARE DEVELOPMENT AND HARDWARE TESTS FOR THE SOLAR MAXIMUM MISSION Final Report
M. E. Bruner and B. M. Haisch 31 Jan. 1986 223 p
(Contract NAS5-24119)
(NASA-CR-177889; NAS 1.26:177889; LMSC-F067851) Avail: NTIS HC A10/MF A01 CSCL 14B

The Ultraviolet Spectrometer/Polarimeter Instrument (UVSP) for the Solar Maximum Mission (SMM) was based on the re-use of the engineering model of the high resolution ultraviolet spectrometer developed for the OSO-8 mission. Lockheed assumed four distinct responsibilities in the UVSP program: technical evaluation of the OSO-8 engineering model; technical consulting on the electronic, optical, and mechanical modifications to the OSO-8 engineering model hardware; design and development of the UVSP software system; and scientific participation in the operations and analysis phase of the mission. Lockheed also provided technical consulting and assistance with instrument hardware performance anomalies encountered during the post launch operation of the SMM observatory. An index to the quarterly reports delivered under the contract are contained, and serves as a useful capsule history of the program activity. B.G.

N86-30807*# Honeywell, Inc., Clearwater, Fla. Space and Strategic Avionics Div.
MODELING AND ANALYSIS OF PINHOLE OCCULTER EXPERIMENT Final Report
J. R. Ring 20 Jun. 1986 84 p
(Contract NAS8-36101)
(NASA-CR-178875; NAS 1.26:178875; CEL-K-156-137) Avail: NTIS HC A05/MF A01 CSCL 14B

The objectives were to improve pointing control system implementation by converting the dynamic compensator from a continuous domain representation to a discrete one; to determine pointing stability sensitivites to sensor and actuator errors by adding sensor and actuator error models to treetops and by developing an error budget for meeting pointing stability requirements; and to determine pointing performance for alternate mounting bases (space station for example). B.G.

N86-30808# Air Force Ballistic Missile Div., Norton AFB, Calif.
NOVEL REENTRY VEHICLE INSTRUMENT: THE PHOTODIODE
S. R. Blodgett, B. T. Conrad, K. W. Shrock, A. C. Wilken, M. W. Sterk, and R. J. Chaffin 1986 12 p Presented at the 3rd Flight Testing Conference, Las Vegas, Nev., 2 Apr. 1986 Prepared in cooperation with Sandia National Labs., Albuquerque, N.M.
(Contract DE-AC04-76DP-00789)
(DE86-006234; SAND-85-2086C; CONF-8604115-1) Avail: NTIS HC A02/MF A01

Photodiodes are used as detectors to provide a simple, inexpensive, and reliable method of obtaining data pertaining to reentry vehicle flight performance. These devices are used primarily to measure boundary layer transition onset, but can also measure vehicle roll rate and roll position. This paper will describe the instrument, construction details, installation, cost, and advantages, and will conclude with supporting flight data. DOE

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N86-30809*# Auburn Univ., Ala. Engineering Experiment Station.
SOLID-PROPELLANT ROCKET MOTOR INTERNAL BALLISTICS PERFORMANCE VARIATION ANALYSIS, PHASE 5 Final Report
Richard H. Sforzini and Jesse E. Murph Jan. 1980 65 p
(NASA-CR-177145; NAS 1.26:177145) Avail: NTIS HC A04/MF A01 CSCL 21H

The results of research aimed at improving the predictability of internal ballistics performance of solid-propellant rocket motors (SRM's) including thrust imbalance between two SRM's firing in parallel are presented. Static test data from the first six Space Shuttle SRM's is analyzed using a computer program previously developed for this purpose. The program permits intentional minor design biases affecting the imbalance between any two SMR's to be removed. Results for the last four of the six SRM's, with only the propellant bulk temperature as a non-random variable, are generally within limits predicted by theory. Extended studies of internal ballistic performance of single SRM's are presented based on an earlier developed mathematical model which includes an assessment of grain deformation. The erosive burning rate law used in the model is upgraded and made more general. Excellent results are obtained in predictions of the performances of five different SRM's of quite different sizes and configurations. These SRM's all employ PBAN type propellants with ammonium perchlorate oxidizer and 16 to 20% aluminum except one which uses carboxyl terminated butadiene binder. The only non-calculated parameters in the burning rate equations that are changed for the

different SRM's are the zero crossflow velocity burning rate coefficients and exponents. The results, in general, confirm the importance of grain deformation. The improved internal ballistic model makes practical development of an effective computer program for application of an optimization technique to SRM design which is also demonstrated. The program uses a pattern search technique to minimize the difference between a desired thrust-time trace and one calculated based on the internal ballistic model.
M.G.

N86-30810# Weapons Systems Research Lab., Adelaide (Australia).
EVALUATION OF IGNITER COMPOSITIONS SR371C AND SR44
L. M. Davis Nov. 1985 20 p
(AD-A167007; WSRL-0424-TM) Avail: NTIS HC A02/MF A01 CSCL 21/2

The ignition performance of compositions SR371C and SR44 in two types of containers was examined in a test vessel. It was found that igniters containing composition SR44 had lower ignition delay times and maximum pressures than those with composition SR371C. It is recommended that further investigations be conducted to determine the minimum mass of composition SR44 required to ignite a given rocket motor. Author (GRA)

N86-30793# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (West Germany).
FIBER REINFORCED PLASTIC CASES FOR SOLID PROPELLANT MOTORS
H. Krings and J. Scharringhausen *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 295-299 Sponsored by ESA, BMFT, DFVLR and CNR (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N86-30811# Lawrence Livermore National Lab., Calif.
CHEMISTRY RESEARCH RESOURCE Monthly Progress Report, Jan. 1986
Feb. 1986 94 p
(Contract W-7405-eng-48)
(DE86-008765; UCID-20622-86-1) Avail: NTIS HC A05/MF A01

The research is reported in twelve sections: synthesis of new materials, development of analytical techniques, chemical kinetics and transport processes, cryogenic and other physical properties of hydrogen isotopes, artificial intelligence, characterization techniques development, materials modeling analysis, mechanical properties of polymers, physical metallurgy (mechanical properties), physical metallurgy (phase transformations), surface modification and surface studies, and new materials development and properties. DOE

24 COMPOSITE MATERIALS

Includes laminates.

N86-30812*# Textron Bell Helicopter, Fort Worth, Tex.
FLIGHT SERVICE EVALUATION OF COMPOSITE COMPONENTS ON THE BELL HELICOPTER MODEL 206L Annual Flight Service Technical Summary Report
H. E. Wilson, II Aug. 1986 53 p
(Contract NAS1-15279)
(NASA-CR-178148; NAS 1.26:178148; AFSR-2) Avail: NTIS HC A04/MF A01 CSCL 11D

This is the second annual report on the flight service components for the Bell Model 206L JetRanger helicopter. The components have been placed in service in the Continental United States, Canada, and Alaska. The report covers the period from 1 August 1983 to 1 January 1986. The status of 34 sets of components is discussed in this report. Approximately 73,000 flight hours were accumulated on the components as of 1 January 1986. Three years of coupon tests on the components are presented with test results. A vertical fin had been struck by lightning and the results of its examination and tests are included. Author

N86-30813# Illinois Univ., Urbana. Dept. of Ceramic Engineering.
INFLUENCE OF Al2O3 ON PROPERTIES OF YTTRIA STABILIZED ZIRCONIA-Al2O3 COMPOSITES Interim Report, Oct. 1985 - Apr. 1986
R. C. Buchanan and W. W. Davison 15 Apr. 1986 43 p
(Contract N00014-80-K-0969; Grant NSF DMR-80-20250)
(AD-A167328; TR-13) Avail: NTIS HC A03/MF A01 CSCL 11/2

Composite structures of yttria (4.5 mol%) stabilized zirconia (YSZ) with added Al2O3 (0.3 to 7.5 wt%) were investigated. Pressed YSZ compacts prepared from submicrometer powders of >99% purity were sintered in the range 1200 to 1350 C for 0.5 to 24 h. Uniform grain size microstructures (0.2 to 0.4 micrometers) were obtained which showed discrete Al2O3 grains dispersed throughout. X-ray diffraction and Raman spectral analysis indicated a combination of both cubic and tetragonal phases. Measured lattice parameters were observed to vary irregularly with Al2O3 content. DC conductivity was found to increase with added Al2O3 less than 3 wt%. Strength vaules obtained for the composites were in excess of 9 Mpa x the squareroot of M (K sub Ic) and 425 MPa (MOR), significantly higher than reported for cubic phase YSZ. The increased strength was attributed to small grain size as well as to crack deflection and arrest mechanisms associated with the dispersed high modulus and lower expansion second phase. The presence of a monoclinic phase was not detected in the samples either before or after fracture, hence the strengthening could not be ascribed to transformation toughening. GRA

N86-30814# Oak Ridge National Lab., Tenn.
IMPROVED FIBER-REINFORCED SiC COMPOSITES FABRICATED BY CHEMICAL VAPOR INFILTRATION
D. P. Stinton, A. J. Caputo, R. A. Lowden, and T. M. Besmann 1986 13 p Presented at the 10th Annual Conference on Composites and Advanced Ceramic Materials, Cocoa Beach, Fla., 19 Jan. 1986
(Contract DE-AC05-84OR-21400)
(DE86-008539; CONF-860152-2) Avail: NTIS HC A02/MF A01

Fabrication of fiber-reinforced composites by a patented chemical vapor infiltration process has continued. Modifications to the process used for infiltration of unidirectional preforms resulted in more uniform matrix deposition throughout the preform and improved mechanical properties of the composites. Infiltration of improved cloth preforms containing more uniform porosity resulted in composites with fewer and smaller voids. DOE

N86-30815# North Carolina State Univ., Raleigh. Dept. of Materials Engineering.
MICROSTRUCTURAL EFFECTS IN SOLID-PARTICLE EROSION Progress Report, 1 Jan. 1985 - 1 Jan. 1986
H. Conrad and R. Scattergood 1986 213 p
(Contract DE-FG05-84ER-45115)
(DE86-008211; DOE/ER-45115/2) Avail: NTIS MF A01

The following were studied: particle feed rate effects during erosion testing; erosion of WC-Co alloys; erosion studies on composites, ceramics, and stainless steel; erosion of SiC reinforced alumina; and erosion mechanisms in Al and Al-Si alloys. DOE

N86-30816# Oak Ridge National Lab., Tenn.
PULSED LASER AND ION BEAM SURFACE MODIFICATION OF SINTERED ALPHA-SiC
K. L. More, R. F. Davis, B. R. Appleton, D. Lowndes, and P. Smith 2 Dec. 1985 9 p Presented at the Symposium on Phase Transitions in Condensed Systems: Experiments and Theory,

Pittsburgh, Pa., 2 Dec. 1985 Prepared in cooperation with North Carolina State Univ., Raleigh and Microelectronics Center or North Carolina, Research Triangle Park
(Contracts DE-AC05-84OR21400; DE-AC05-76QR-00033)
(DE86-008978; CONF-851260-3) Avail: NTIS HC A02/MF A01

Pulsed laser annealing and ion beam mixing have been used as surface modification techniques to enhance the physical properties of polycrystalline (ALPHA)-SiC. Thin Ni overlayers (20 nm to 100 nm) were evaporated onto the SiC surface. The specimens were subsequently irradiated with pulses of a ruby or krypton fluoride (KrF) excimer laser or bombarded with high energy Xe(+) or Si(+) ions. Both processes are nonequilibrium methods and each has been shown to induce unique microstructural changes at the SiC surface which are not attainable by conventional thermal treatments. Under particular (and optimum) processing conditions, these changes considerably increased the mechanical properties of the SiC; following laser irradiation, the fracture strength of the SiC was increased by as much as 50%, but after ion beam mixing, no strength increase was observed. High resolution cross-section transmission electron microscopy (X-TEM), scanning electron microscopy (SEM), and Rutherford backscattering techniques were used to characterize the extent of mixing between the Ni and the SiC as a result of the surface modification. DOE

N86-30817# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France).
HOLOGRAPHY: THE NONDESTRUCTIVE TESTING OF COMPOSITE STRUCTURES
P. Barbier and C. LeFloch 1986 6 p Presented at 3rd European Symposium on Spacecraft Material on Space Environment, Noordwijk, Netherlands, 3 Oct. 1985 Previously announced in IAA as A86-22611
(SNIAS-861-430-103; ESA-86-97165) Avail: NTIS HC A02/MF A01

Industrial applications of holography are discussed. The principle of nondestructive testing by laser holographic interferometry, and the parts to be tested (parts of motor case in composite materials) are described. The test facility, which involves a complex mechanical system, is presented, and the technical choices are justified. Economic aspects are treated. ESA

N86-30761# National Engineering Lab., East Kilbride (Scotland).
FATIGUE AND DAMAGE IN FIBRE REINFORCED NYLON
W. S. Carswell *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 25-29 Sponsored by UK Dept. of Trade and Industry (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30763# Atomic Energy Research Establishment, Harwell (England). Materials Development Div.
DYNAMIC MECHANICAL ANALYSIS AS AN AID TO THE CHARACTERIZATION OF COMPOSITE MATERIALS
D. H. Bowen, R. Davidson, R. J. Lee, and M. Aguirre *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 39-46 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30766# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
ORTHOTROPIC PROPERTIES OF LAYERED FIBER COMPOSITES
G. R. Kress *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 65-70 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30767# Waldrich Siegen Werkzeugmaschinen G.m.b.H., Burbach (West Germany).
THEORETICAL AND EXPERIMENTAL BEHAVIOR OF CARBON FIBER REINFORCED PLASTICS UNDER MECHANICAL AND THERMAL LOAD
U. Bieling *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 71-78 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30771# Brussels Univ. (Belgium).
NEW PREDICTION METHODS FOR COMPOSITES HYGROTHERMAL BEHAVIOR
C. C. Hiel *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 101-107 Sponsored by NAS-NRC and NATO (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30774# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Aeronautical Structures and Materials.
THERMAL STABILITY OF SANDWICH REFLECTORS
H. Groth *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 133-139 Sponsored by Ericsson Radio System (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30782# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
ON THE DEFECT SENSITIVITY OF SPACECRAFT TYPICAL THIN CFRP LAMINATES
J. Bischoff *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 203-209 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30783# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
INTEGRITY OF CARBON FIBER REINFORCED PLASTICS. STRUCTURAL ELEMENTS, SCREENING PROCEDURES, OPPORTUNITIES AND OPEN ISSUES
Werner H. Paul *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 211-215 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

N86-30818*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RADIATION DATA DEFINITIONS AND COMPILATION FOR EQUIPMENT QUALIFICATION DATA BANK
Frank L. Bouquet and John W. Winslow 1986 215 p
(Contract NAS7-100)
(NASA-CR-176259; NAS 1.26:176259; NPO-16426/5907) Avail: NTIS HC A10/MF A01 CSCL 07D

Dose definitions, physical properties, mechanical properties, electrical properties, and particle definitions are listed for insulators and dielectrics, elastomeric seals and gaskets, lubricants, adhesives, and coatings. B.G.

N86-30819# Princeton Univ., N. J. Dept. of Chemical Engineering.
REACTIONS OF ORGANIC MOLECULES ON TRANSITION METAL SURFACES Final Report, 1 Sep. 1982 - 31 Oct. 1985
Jay B. Benziger Feb. 1986 14 p
(Grant AF-AFOSR-0302-82)
(AD-A166214; AFOSR-86-0148TR) Avail: NTIS HC A02/MF A01

CSCL 07/4

This project has examined reactions of organic molecules on transition metal surfaces to develop a mechanistic framework for clasifying surface reactions. Electron and mass spectroscopies in conjunction with infrared spectroscopy have been used to examine reactions of organic compounds on well characterized tungsten and nickel surfaces in vacuum, as well as using voltammetry with infrared spectroscopy to study reactions on platinum electrodes. The semi-infinite nature of the metal surface provides a reagent that can act as both an electron donor and acceptor from the same Fermi level. The surface also imposes steric constraints that cause dramatic changes in adsorption with subtle changes in molecular structure. These effects have been demonstrated through spectroscopic measurements of the molecular orientation and surface reactions of benzene and pyradine and their methyl-substituted derivatives on a Ni(100) surface. GRA

N86-30820# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.

LASER SPECTROSCOPY OF OZONE Final Report, 1 Jul. 1980 - 30 Sep. 1985

James L. Kinsey 18 Dec. 1985 11 p

(Contract F19628-80-K-0088)

(AD-A166516; AFGL-TR-86-0006) Avail: NTIS HC A02/MF A01 CSCL 07/4

Data have been obtained for the first time on the fluorescence spectrum of ozone in the Hartley continuum region. This type of data provides information for a new kind of spectroscopy with hitherto unprecedented capabilities for studying both ground state vibrational structure and excited state dissociation dynamics. From this data and theoretical models, qualitative generalizations are made about the potential energy surface of the electronic state of the Hartley transition. Experiments have also been conducted to obtain the high resolution spectrum of some of the Huggins bands for jet-cooled ozone. An analysis of the partially resolved rotational structure of these bands indicates that the symmetry of the Huggins bands is the same as that for the Hartley continuum. GRA

N86-30821# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

THE USE OF A PYROCHEMILUMINESCENT NITROGEN ANALYZER AS A CAPILLARY GC (GAS CHROMATOGRAPH) DETECTOR Final Report, Mar. - May 1985

Edward W. Pitzer Feb. 1986 21 p

(AD-A166597; AFWAL-TR-85-2077) Avail: NTIS HC A02/MF A01 CSCL 07/4

A study was conducted to determine the feasibility of interfacing a pyrochemiluminescent nitrogen analyzer to a high resolution glass capillary gas chromatograph. The instruments used were a Varian Model 3700 gas chromatograph and an Antek Model 703C pyrochemiluminescent nitrogen analyzer. Known standards of nitrogen containing compounds were prepared in shale derived jet propulsion fuel that had been previously determined to have no nitrogen containing species. These solutions were then chromatographed on the GC/CLD system. The resulting data were reduced using relative response factors with an internal standard. The nitrogen content of the standard solutions were validated by analyses on a separate Antek nitrogen analyzer used to determine total nitrogen content. The method of GC/CLD was deemed feasible. However, it is recommended that appropriate design changes be made to the Antek Model 703C nitrogen analyzer to accommodate the type of flows common with capillary gas chromatographs. GRA

N86-30822# California Univ., Berkeley. Dept. of Mechanical Engineering.

A LINEAR ARRAY FOR RAYLEIGH SCATTERING Final Report, 1 Sep. 1983 - 31 Jan. 1985

L. Talbot 11 Jun. 1985 27 p

(Grant AF-AFOSR-0229-83)

(AD-A167109; AFOSR-86-0161TR) Avail: NTIS HC A03/MF A01 CSCL 07/4

Gas density under combustion conditions can be obtained by measuring the intensity of the molecular (Rayleigh) scattering of light from a laser beam. A system which obtains an essentially continuous record of the density along a length of the laser beam is described. The temperature and degree of combustion can thus be determined for a number of interesting combustion configurations, which will ultimately lead to a better description and understanding of combustion flow flame field phenomena. An image of Rayleigh scattered light from the combustion region is projected onto a monolithic self scanning linear photodiode array by means of a lens, bandpass filter, slit, image intensifier, and fiber optic reducer. The video output of the linear array is digitized and stored, creating a space-time map of the density which can be visualized and manipulated as an image. Analysis of these images by image processing techniques gives qualitative and quantitative information about such features of the combustion zone as flame wrinkling and periodicity, flame thickness and continuity, and other structural and time dependent properties in the combustion region. Following a brief introduction, the components are described, the system performance characteristics are discusssed, and an example of a processed image from a simple turbulent flame is presented. GRA

N86-30823# Pittsburgh Univ., Pa.

MEASUREMENT OF RATE CONSTANTS OF ELEMENTARY GAS-REACTIONS OF IMPORTANCE TO UPPER ATMOSPHERE AND COMBUSTION SYSTEMS Final Report, 14 Dec. 1984 - 13 Dec. 1985

Frederick Kaufman 24 Feb. 1986 10 p

(Grant AF-AFOSR-0044-85)

(AD-A167177; AFOSR-86-0222TR) Avail: NTIS HC A02/MF A01 CSCL 14/2

This report discusses the Air Force's enhanced flow reactor. The major items purchased were a bakeable, differentially pumped, UHV envelope to interface the mass spectrometer to the flow tube and an excimer pumped dye laser system for laser excited fluorescence (LEF) detection of radicals in the flow tube. The LEF system, employing a Lambda Physik excimer pumped dye laser (EMG 103 MSC/FL 2001), has been operational since mid-autumn. It has already been used in preliminary studies of our new methoxy radical source. Completion of the mass spectrometer system was delayed by a variety of problems. However, by late October the required parts were on hand, and the vacuum envelope, sans mass spectrometer, was successfully pumped down. The complete system is currently assembled and undergoing final testing. GRA

N86-30824# Lawrence Livermore National Lab., Calif.

X-RAY ABSORPTION SPECTROSCOPY

C. L. S. Lewis 14 Nov. 1985 8 p

(Contract W-7405-eng-48)

(DE86-006728; UCRL-15731) Avail: NTIS HC A02/MF A01

An X-ray absorption spectrometric technique is described. A preliminary experiment to observe emission lines from a wide range of targets was attempted. DOE

N86-30825# Mound Lab., Miamisburg, Ohio.

CHARACTERIZATION AND ANALYSIS OF ENERGETIC AND PLASTIC MATERIALS BY THERMAL ANALYSIS MASS SPECTROMETRY (TA/MS)

R. O. Yelton and T. L. Shell 1985 12 p Presented at the Joint Department of Defense/Department of Energy Explosives Surveillance Meeting, Albuquerque, N. Mex. 3 Dec. 1985

(Contract DE-AC04-76DP-00053)

(DE86-006140; MLM-3330(OP); CONF-851256-5) Avail: NTIS HC A02/MF A01

A thermal analysis mass spectrometer (TA/MS) system was developed where a differential scanning calorimeter and a thermogravimetric analysis instrument were interfaced to a computer controlled quadrupole mass spectrometer in order that thermal data as well as mass spectrometric information on the gaseous by-products of decomposition may be simultaneously obtained during the analysis of energetic and plastic materials. Examples of the applications of TA/MS in the characterization of

explosive powders, WR plastics, and a field aged MC-3003 propellant grain formulation are presented. DOE

N86-30826# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
MODELING AND DIAGNOSTICS OF COMBUSTION IN SPARK-IGNITION ENGINES
F. V. Bracco 1985 13 p Presented at the International Symposium on Diagnostics and Modeling of Combustion in Reciprocating Engines, Tokyo, Japan, 4 Sep. 1985
(Contract DE-AC04-81AL-16338)
(DE86-008173; CONF-850915-1) Avail: NTIS HC A02/MF A01

Subjects are considered that have not been extensively covered in recent reviews. The following is concluded. Simple ensemble averaging is not suited for engine flows. In an engine, what is turbulence and what is bulk (mean) flow is relative to the process that is influenced by the flow. Near TDC, turbulence is always insensitive to the details of the turbulence generated during intake. For a given engine, without strong squish and/or swirl, turbulence intensity and diffusivity near TDC increase with increasing initial turbulent diffusivity but run into upper limits imposed by turbulence damping due to the chamber walls. In spite of many uncertainties and limitations, multi-dimensional combustion models have been shown to be useful by industrial applications. Improved modeling of the flame structure is the subject of greatest current interest. Spatially and temporally resolved measurements are needed of: turbulence intensity with combustion; turbulence length scales without and with combustion; flame establishment and structure; interactions of flame and walls; and the onset of knock. DOE

N86-30827# Los Alamos National Lab., N. Mex.
USING TEMPERATURE-PROGRAMMED REACTION FOR KINETIC ANALYSIS OF REACTIONS IN DILUTE AQUEOUS SOLUTIONS AT HIGH PRESSURE
L. F. Brown and B. A. Robinson 1986 26 p Presented at the 9th International Symposium on Chemical Reaction Engineering, Philadelphia, Pa., 18 May 1986
(Contract W-7405-eng-36)
(DE86-003683; LA-UR-85-3936; CONF-860530-2) Avail: NTIS HC A03/MF A01

The technique of temperature-programmed reaction (TPR) is shown to be a practical experimental method for determining reaction-rate expressions and kinetics parameters for reactions in dilute aqueous solutions under high ambient pressure. By sampling and measuring the extent of reaction during a rise in temperature, information normally obtained from a series of isothermal batch kinetics experiments can be found in a single TPR test. The use of nonlinear least-squares regression eliminates the need to achieve a constant rate of temperature rise, simplifies the experimental requirements for TPR results, and gives more accurate answers than does a linear analysis of TPR results. Numerical simulations of TPR tests in the presence of random concentration-measurement error is used to assess the accuracy of the technique and to identify the best values of crucial operating parameters. The results of two TPR experiments measuring the alkaline hydrolysis of ethyl acetate demonstrate the applicability of the technique to reactions in dilute aqueous solutions at high pressure. These preliminary experimental results, along with numerical simulations, allow us to chart a course for future TPR kinetics experiments on a large number of similar reactions. DOE

N86-30828# Purdue Univ., West Lafayette, Ind. School of Mechanical Engineering.
EXPERIMENTAL VALIDATION OF DIESEL SPRAY COMBUSTION Annual Report
Colin R. Ferguson 1985 83 p
(Contract DE-AC04-81AL-17085)
(DE86-007773; DOE/AL-17085/T2) Avail: NTIS HC A05/MF A01

Multidimensional models are being developed to predict flow, heat transfer and combustion within internal combustion engines. Measurements have been made of the total rate of heat loss and the half radius swirl velocity of an unsteady, turbulent swirling flow within a cylinder for different aspect ratios. The instantaneous heat loss correlates with the half radius swirl velocity by Nusselt-Reynolds number power law. The correlation is independent of aspect ratio if the filling of the cylinder results in a flow field which is axi-symmetric and shows no axial variation outside the boundary layers. Heat loss and angular momentum decay in a constant volume cylindrical vessel is of interest because the flow has features similar to flows in internal combustion engines. The relationship of the ideal experiment to the more practical case is analogous to the relation between a flat plate and an airfoil. A technical review of laser shadowgraph, contract schlieren and color schlieren flow visualization techniques is presented. Demonstration experiments are performed to graphically illustrate the effects of system design variables on image quality. Techniques for obtaining exposure durations on the order of ten microseconds or less are demonstrated. DOE

N86-30829# Sandia National Labs., Albuquerque, N. Mex.
SANDIA COOPERATIVE GROUP ON THE AEROTHERMOCHEMISTRY OF TURBULENT COMBUSTION
S. C. Johnston Mar. 1986 43 p
(Contract DE-AC04-76DR-00789)
(DE86-008838; SAND-86-8213) Avail: NTIS HC A03/MF A01

A turbulent reacting flow working group has been established through the Department of Energy/Office of Basic Energy Sciences. The purpose of this group is to establish and maintain a strong interaction and active dialogue between workers currently involved in modeling turbulent reacting flows and those involved in related experiments. One objective of this collaboration is to develop an increased understanding of the fundamental interaction between the chemical and fluid dynamical processes occurring in chemically reacting flows, and to utilize this understanding to improve predictive capabilities for turbulent combustion of hydrocarbon fuels. Regular members, who represent academia, private industry, and national laboratories, and guests participate in the meetings. Several guests are invided to each meeting to provide an influx of different ideas and opinions to the discussions. This document is a summary of the discussion that took place during the sixth meeting, which was held at Cornell University on October 7 to 8, 1985. DOE

N86-30830# Pacific Northwest Labs., Richland, Wash.
MODEL OF CRACK ELECTROCHEMISTRY
C. A. Oster and M. J. Danielson Mar. 1986 58 p
(Contract DE-AC06-76RL-01830)
(DE86-009346; PNL-5821) Avail: NTIS HC A04/MF A01

This document describes a rather general mathematical model of crack tip electrochemistry. First the general mass transport problem is discussed along with the chemistry expected to take place within the crack. The final equations used are extracted and the numerical algorithm presented for producing the final approximation to the original problem. At least two items have been ignored in the paper. A number of models for the crack tip exist. Only one is described here. Initial experience indicates that other geometries may complicate things during computation but have little effect on the final solution. The second item involves limiting the electrochemistry by solubility limits. Experiments indicate that when precipitation of $Ni(++)$ occurs there is a dramatic reduction in anodic current. Indeed, examination of the boundary condition and other governing equations indicate that if precipitation occurs over any finite continuous interval which includes the tip, then the total anodic current at the tip vanishes. Hence the crack growth from corrosion stops. This observation indicates that more research is needed to obtain a useful model of the crack tip when precipitation occurs. DOE

N86-30831# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
SILICA GEL SORPTION PROPERTIES UNDER ADIABATIC CONDITIONS
A. A. Pesaran and K. Choudhury Feb. 1986 61 p
(Contract DE-AC02-83CH-10093)
(DE86-004439; SERI/TR-252-2704) Avail: NTIS

HC A04/MF A01

The SERI Sorption Test Facility was modified from isothermal operation to adiabatic operating conditions so that we could measure the adsorption/desorption characteristics of silica-gel-coated, parallel-channel geometry as a function of operating conditions and aspect ratio under adiabatic conditions. We performed single-blow experiments on two single-passage test cells with different aspect ratios, air flow rates, and inlet conditions. Both adsorption and desorption runs were performed. As the air flow rate and aspect ratio increase when other parameters are kept constant, the desiccant matrix loses its sorption capacity faster. The test cell operated near isothermal conditions rather than adiabatically because the cell walls had a large thermal mass compared with the amount of desiccant used. Since constructing single-passage test cells with small thermal masses that can be operated adiabatically at the Sorption Test Facility is difficult, further testing at this facility will be primarily for isothermal operation. The adiabatic experiments can best be done with multipassage test cells having small thermal masses relative to desiccant mass. A single-blow test facility for performing experiments with multipassage test cells was fabricated in FY 1984, and experiments were performed in an FY 1985 desiccant project. DOE

N86-30832# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany). Abt. Mechanik.

STRUCTURE OF THE EQUATION OF STATE OF REAL GASES AND LIQUIDS [STRUKTUR DER ZUSTANDSFUNKTION REALER GASE UND FLUESSIGKEITEN]

J. Bortfeldt Dec. 1985 26 p In GERMAN; ENGLISH summary
(PTB-Me-69; ISSN-0341-6720; ESA-86-97415) Avail: NTIS HC A03/MF A01

Questions concerning the structure of the equation of state of real gases and liquids were studied. The virial theorem of mechanics and an assumption on the expression for potentials were used. Data for water were used to get an insight into the behavior of real matter. The result valid for a perfect Bose-Einstein gas was also confirmed for real gases: at each temperature there is a maximum density at which condensation begins to occur, dividing the fluid into saturated gas and liquid. In real gases this maximum density is exactly correlated to the minima of the isotherms of the real factor Z which appear in the domain of the International Skeleton Table of water up to the 600 C isotherm. The pressure range (up to 1000 bar) is too low for the appearance of minima at higher temperatures. The domain of this table for water (pressure between 1 and 1000 bar; temperature between 200 and 800 C; specific density between 0.2 and 924 kg/cum) is well described. ESA

N86-30833# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna. Inst. fuer Reaktorsicherheit.

POTASSIUM-WATER REACTIONS IN THE VAPOR PHASE

Norbert Schwarz, Milos Komurka, and Hans Lichtl Jul. 1985 37 p In GERMAN; ENGLISH summary
(OEFZS-4327; RS-260/85; ESA-86-97065) Avail: NTIS HC A03/MF A01

The possible reactions of water leaking into a potassium condenser were investigated. The emphasis was on the development of pressure in the K-condenser and the expected reaction products. Theoretical considerations on possible reactions and reaction products, and the thermodynamics of K-reactions are given. The K-H2O reaction experiments are described. It is shown that water leakages into a potassium condenser are much less dangerous than expected on the basis of first estimations. The pressure increase is not only determined by the simple K-H2O reaction but also strongly by other reactions. The obtained maximum pressure is quickly reduced. For small continuous leaks an equilibrium is obtained. ESA

N86-30834# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna. Inst. fuer Reaktorsicherheit.

POTASSIUM INSTRUMENTATION AND EXPERIMENTS ON POTASSIUM VAPOR

Norbert Schwarz and Hans Lichtl Jul. 1985 19 p In GERMAN; ENGLISH summary
(OEFZS-4328; RS-261/85; ESA-86-97066) Avail: NTIS HC A02/MF A01

Temperature and pressure instrumentation for the investigation of potassium boiling phenomena were tested. In a small test rig thermocouples and a pressure transducer were tested in potassium at 870 C. A potassium vapor flame was generated by producing an artificial leak. The development of flame and aerosol was filmed. The measured data are qualitatively described. The vapor flame test confirms the good performance of the pressure measurement. The high rate of temperature changes does not allow a correct temperature measurement. The investigation of boiling phenomena thus requires directly immersed probes. ESA

N86-30835# Yale Univ., New Haven, Conn. Section of Applied Physics.

IN SITU MONITORING OF ELECTROCHEMICAL REACTIONS BY SURFACE ENHANCED RAMAN SCATTERING Final Report, 1 Jul. 1983 - 31 Dec. 1985

Richard K. Chang and Victor E. Henrich Feb. 1986 45 p
(Contract GRI-5083-260-0795)
(PB86-201076; GRI-86/0054) Avail: NTIS HC A03/MF A01 CSCL 07D

Surface enhanced Raman scattering (SERS) was applied in investigating the nature of the water adsorbates and the protonation of Ag-oxides on Ag electrodes immersed in various electrolytes and undergoing oxidation-reduction cycles. The vibrational frequency of the O-D stretching mode of water adsorbates was determined for the two possible orientations (oxygen pointing away from or toward the Ag surface) and the two possible species (deuterium or hydrogen) on the other bond. To better quantify the SERS on metallic microstructures, e-beam lithography was used to produce microstructure arrays of uniform size, shape, and separation. The experimental studies on coinage metal surfaces provide information as to how SERS can be extended to catalytically more interesting metal surfaces. GRA

N86-31410*# Alabama Univ., Birmingham. Dept. of Physics.

MOSSBAUER SPECTROSCOPY OF EXTRATERRESTRIAL MATERIALS

David G. Agresti *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 10 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 07D

N86-31419*# New Mexico State Univ., Las Cruces. Dept. of Mechanical Engineering.

FIRE CONTROL METHOD AND ANALYTICAL MODEL FOR LARGE LIQUID HYDROCARBON POOL FIRES

Donald L. Fenton *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 14 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 21B

N86-31423*# LeTourneau Coll., Longview, Tex. Dept. of Chemistry.

REVIEW AND ANALYSIS OF HIGH TEMPERATURE CHEMICAL REACTIONS AND THE EFFECT OF NON-EQUILIBRIUM CONDITIONS

Richard E. Johnson *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 19 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 07D

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N86-30836 British Library Lending Div., Boston Spa (England).

STUDY OF SETTLING OF METALLIZED SINTER IN REDUCING

ATMOSPHERE
A. R. Zhak, A. N. Pyrikov, and V. M. Borisov 1985 3 p Transl. into ENGLISH from Izvestiya VUZ Chernaya Metallurgiya (USSR), v. 7, 1985 p 161-162
(BLL-M-36597-(5828.4)) Avail: British Library Lending Div., Boston Spa, Engl.

Utilization of the reducing capacity of gases during the complete reduction of partially metallized materials by solid carbon in an arc steel making furnace is examined. During heating, the layer of charge shrinks (compacts) under the pressure of the mass of charge materials lying above it. Results show that an increase in the fuel consumption raises the temperature at the start of shrinkage and simultaneously reduces the shrinkage range. B.G.

N86-30837*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE VARIATION OF CORROSION POTENTIAL WITH TIME FOR COATED METAL SURFACES
Merlin D. Danford and Ward W. Knockemus (Huntingdon Coll., Montgomery, Ala.) Sep. 1986 27 p
(NASA-TP-2636; NAS 1.60:2636) Avail: NTIS HC A03/MF A01 CSCL 11F

The variation of corrosion potential (EsubCORR) with time has been measured for 4130 steel coated with a preservative compound and for primer coated 2219-T87 aluminum. The data for coated steel samples show a great deal of scatter, and a smoothing procedure has been developed to enable proper interpretation of the data. The EsubCORR-time curves for coated steel exhibit a maximum, in agreement with the results of previous studies, where the data were the average of those for a large number of samples, while the present data were obtained from a single sample. In contrast, the EsubCORR-time curves for primer coated 2219-T87 aluminum samples show no significant variations, although considerable activity is indicated by the resistance-time and corrosion rate-time curves. Author

N86-30838# Dayton Univ., Ohio. Research Inst.
ADVANCES IN THE STUDY OF THE MECHANICAL BEHAVIOR OF MATERIALS Final Report, 15 Jun. 1981 - 30 Sep. 1984
Noel E. Ashbaugh, M. Khobaib, T. Weerasooriya, George A. Hartman, A. M. Rajendran, D. C. Maxwell, and R. C. Goodman Dec. 1985 138 p
(Contract F33615-81-C-5015; AF Proj. 2307)
(AD-A164656; AFWAL-TR-85-4124) Avail: NTIS HC A07/MF A01 CSCL 11/6

The design of high performance aircraft engines requires the development of reliable life-predication methodology to aid in the evaluation and safety of the critical gas-turbine engine components. A comprehensive multi-task research and development program was conducted to establish a sound life-prediction methodology. The program consisted mainly of: (1) Experimental investigations and analytical modeling of crack growth behavior; (2) Experimental investigation of mechanical properties and performance characteristics of structural materials; (3) Environmental effect on elevated temperature mechanical behavior; and (4) Development of test techniques, upgrading, and maintenance of the AFWAL/MLLN Mechanical Test Facility. GRA

N86-30839# Massachusetts Inst. of Tech., Cambridge. Materials Processing Center.
MICROSTRUCTURE/PROPERTY RELATIONSHIPS FOR CARBON FIBER REINFORCED ALUMINUM ALLOYS Final Report
R. G. Dixon, J. A. Cornie, and M. C. Flemings 25 Jul. 1985 108 p
(Contract N00014-83-K-0677)
(AD-A165992) Avail: NTIS HC A06/MF A01 CSCL 11/6

Graphite fibers with various coatings were tested for strength. Longitudinal composites were produced from the coated fibers using pure aluminum as the matrix by pressure casting. The strength and microstructure of the composites was evaluated. Longitudinal and transverse composites were also produced using uncoated graphite fibers with various alloy matrices and their strength and microstructure evaluated. The coated fibers were leached from the pure aluminum matrix and examined. The uncoated graphite fibers were leached from the alloy matrices and tested for strength. The coated fibers were not found to be stronger than the uncoated fibers, nor were they effective in increasing composite strengths. Composites produced from uncoated fibers and alloy matrices were quite strong longitudinally with strengths of up to 93 percent of rule of mixtures strength. The same material, when tested in the transverse direction exhibited low strengths, with the failure being interfacial. Author (GRA)

N86-30840# Johns Hopkins Univ., Baltimore, Md. Dept. of Physics and Astronomy.
FERROMAGNETIC RELAXATION IN ULTRATHIN FILMS OF AMORPHOUS ALLOYS Final Report, 15 Jul. 1985 - 15 Feb. 1986
George T. Rado 4 Apr. 1986 13 p
(Contract N00014-85-K-2027)
(AD-A166727) Avail: NTIS HC A02/MF A01 CSCL 11/6

It is suggested that the shielding effectiveness of devices designed for electromagnetic pulse (FMR) mitigation could be significantly improved by the use of ferromagnetic materials which are amorphous rather than crystalline. Prior to investigating ferromagnetic relaxation, i.e., magnetic losses, in such materials, it is necessary to understand ferromagnetic resonance field (or frequencies), especially for materials in the form of ultrathin films. In the present report this aim is accomplished by the development and use of a method which allows the first reliable measurement of magnetic surface anisotropy. GRA

N86-30841# Naval Ocean Systems Center, San Diego, Calif.
COMPREHENSIVE CHEMICAL ANALYSIS OF METAL ALLOYS BY MEANS OF INDUCTIVELY COUPLED PLASMA OPTICAL EMISSION SPECTROSCOPY Interim Report, Oct. 1984 - Sep. 1985
W. E. Glad Oct. 1985 27 p
(AD-A166842; AD-E950814; NOSC/TR-1078) Avail: NTIS HC A03/MF A01 CSCL 11/6

The purpose of this study was to extend the analysis capability of inductively coupled plasma (ICP) optical spectroscopy to as many different copper, aluminum, and iron base alloys as possible, and investigate the development of analytical methods capable of determining all important elements in a particular base through the use of a single set of analytical lines and a single preparation method. Analyses of standard reference materials show that the analysis lines used were effective for determining those elements which can be brought into solution, particularly copper, chromium, cobalt, manganese, molybdenum, silicon, vanadium, and phosphorous. Other materials, notably aluminum, boron, titanium, niobium, tungsten, and zirconium in an iron base were more difficult to analyze, probably because they form carbides or other species that are difficult to dissolve. The uses of NaOH/H2O2 to dissolve aluminum base material and HC1/H2O2 to dissolve copper base material show promise as good comprehensive dissolution techniques. The conductive solids nebulizer (CSN) proved effectivein bypassing the dissolution step. GRA

N86-30842# Battelle Columbus Labs., Ohio.
EFFECT OF MANUFACTURING PROCESSES ON STRUCTURAL ALLOWABLES, PHASE 1 Final Report, 29 Jun. 1984 - 29 Jul. 1985
Paul E. Ruff Jan. 1986 95 p
(Contract F33615-84-C-5030)
(AD-A166857; AFWAL-TR-85-4128) Avail: NTIS HC A05/MF A01 CSCL 11/6

This report contains the results of tests to determine the effect of manufacturing processes on the mechanical properties of four aerospace materials, 7149-T73 hand forgings, Ti-15V-3Cr-3Sn-3A1 solution treated sheet, 15-5PH (H935) castings, and Inconel 718 solution treated and aged sheet. Tensile, compression, shear,

bearing, and fatigue (notched and unnotched for three stress ratios), except for 15-5PH (H935) castings, properties were obtained.GRA

N86-30843# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
THE EFFECT OF BAKING AND STRESS ON THE HYDROGEN CONTENT OF CADMIUM PLATED HIGH STRENGTH STEELS Progress Report
D. A. Berman Dec. 1985 24 p
(AD-A166869; NADC-86035-60) Avail: NTIS HC A02/MF A01 CSCL 11/6

Variations in the diffusible hydrogen concentration of cadmium plated AISI 4340 and 300M steels due to baking and stress are reported. Long baking times of greater than 100 hours at 190C are needed to remove all the hydrogen from bright cadmium plated specimens, and around 40 hours for dull cadmium plated ones. Very short baking not only does not remove hydrogen, but actually pumps it in. Baking for 96 hours is insufficient to remove hydrogen embrittlement from sharp, double notched 300M tensile specimens having a notched tensile strength of 1800 MPa. It is shown that there is not difference in the hydrogen concentration does not change with time for cadmium plated specimens standing for one month at room temperature. Stressing, on the other hand, causes an increase in the hydrogen, presumably by allowing it to enter from the plate due to lattice deformation. GRA

N86-30844# Naval Research Lab., Washington, D. C.
AN INVESTIGATION OF STRESS-CORROSION CRACKING SUSCEPTIBILITY IN CANDIDATE STEELS FOR TENSION LEG PLATFORM TENDONS Interim Report
J. A. Hauser, II and T. W. Crooker 24 Apr. 1986 15 p
(AD-A167286; NRL-MR-5773) Avail: NTIS HC A02/MF A01 CSCL 13/13

Consideration of the use of high-strength steels in tension leg platform (TLP) tendons raises questions concerning the possibility of stress-corrosion cracking (SCC) occurring over long periods of time. For this reason, an investigation was undertaken to experimentally characterize the SCC susceptibility of eleven candidate materials using state-of-the-art fracture mechanics methodology. The materials studied in this program were provided by Conoco, Inc. and Chevron Corporation from samples being characterized to TLP service. The materials included steels in various product forms including forgings, rolled plate and weldments with yield strengths ranging from 80 to 125 ksi. The SCC tests were conducted at the NRL Marine Corrosion Research Laboratory in Key West, Florida. Bolt-loaded wedge-opening-loaded precracked specimens were exposed to fresh flowing natural seawater while cathodically coupled to zinc anodes for a minimum of 8,000 hours (333 days). No evidence of SCC susceptibility was found in any of the materials tested. A limited number of additional experiments were conducted to further confirm this favorable finding. Static-load SCC does not appear to pose a threat to the structural integrity of high-strength steel TLP tendons. GRA

N86-30845# Universidade Federale do Rio de Janeiro (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia.
CORROSION FATIGUE OF ZIRCALLOY-4 IN CHLORIDE MEDIUM Tese (M.Sc.)
C. S. S. Monnerat 1984 86 p In PORTUGUESE; ENGLISH summary
(DE86-780339; INIS-BR-373) Avail: NTIS (US Sales Only) HC A05/MF A01

The fatigue behavior of Zircalloy-4 in a O.5 M NaCl aqueous solution was studied. The tests were performed under potenciostatic control at room temperature and mean frequency of 80 Hz. The tests have shown that Zircalloy-4 does not have its fatigue life decreased under cathodic potentials action. The application of anodic potentials, however, has markedly influenced the life of the material. This influence is characteristic for a certain range of applied potential and cyclic stress level. It was shown that, for a maximum stress higher than yield stress and potential values higher than +120 mV sub(sce), the life of the material was drastically reduced due to pit formation and intergranular attack. This critical potential is, however, lower than the pit potential (approx. +180 mV sub(Sce)) obtained by the usual electrochemical methods. For maximum cyclic stress lower than the yield stress, the material did not fail even at potential values higher than the critical +120 mV sub(sce). The application of potential values lower than +120 mV sub(sce) led to an increase in the fatigue properties of the material, that is characterized by an increase in fatigue life as compared to that observed in air. This behavior is attributed to the high velocity of repassivation presented by Zircalloy-4. DOE

N86-30846# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
GRAIN BOUNDARY DISLOCATION STRUCTURES IN [001] SYMMETRIC TILT BOUNDARIES IN ALUMINUM
J. S. Liu and R. W. Balluffi Aug. 1985 20 p
(Contract DE-FG02-84ER-45116)
(DE86-007003; DOE/ER-45116/8) Avail: NTIS HC A02/MF A01

Grain boundary dislocation (GBD) structures were studied in (001) symmetric tilt boundaries in aluminum bicrystals of controlled geometry using transmission electron microscopy. The intrinsic GBD structure of near-(SIGMA)1, (SIGMA)5 and (SIGMA)13 boundaries consisted of families of straight edge GBDs with Burgers vectors b = <100> or 1/2<110>, 1/10<310> and 1/26-<510>, respectively. In each case the system chose GBDs with the smallest perfect Burgers vector perpendicular to the boundary in agreement with previous computer simulations using the method of molecular statics and a pairwise pseudo potential model. In addition, the b = <100> GBDs were straight and not serrated due to dissociations into partial GBDs and patches of stacking fault, as they are in gold according to earlier work. This result was attributed to the higher stacking fault energy of aluminum. Observations were also made of extrinsic GBD structures produced by the superposition of lattice dislocations on the intrinsic GBD arrays. The results were consistent with structures which could be obtained by a sequence of reactions in which each lattice dislocation dissociated into GBDs possessing Burgers vectors corresponding to the boundary DSC Lattice which then interacted in various ways with the intrinsic array. DOE

N86-30847# Oak Ridge National Lab., Tenn.
SENSITIVITY ANALYSIS OF A NUMERICALLY SIMULATED HgCdTe SOLIDIFICATION PROCESS BY STATISTICAL METHODS
M. Morris and V. Alexiades Feb. 1986 19 p
(Contract DE-AC05-84OR-21400)
(DE86-007935; ORNL-6210) Avail: NTIS HC A02/MF A01

Statistical response surface methodology is applied to the problem of determining simple approximations for outputs as functions of input parameter values in a numerical simulation of the solidification of a mercury-cadmium-telluride alloy. The approximating polynomials are then differentiated with respect to parameter values to determine sensitivities. A table of percent changes in output values as a result of 1% changes in parameter values is presented. The empirical procedure used constitutes an unorthodox application of the statistical methodology, but it is easy to use, quite generally applicable and very effective. DOE

N86-30848# Commission of the European Communities (Luxembourg). Community Bureau of Reference.
CERTIFICATION OF CARBON, NITROGEN AND OXYGEN IN ZIRCALOY. (BCR NOS. 275 AND 276)
C. Vandecasteele, H. Marchandise, and E. Colinet 1984 38 p
(DE86-750679; EUR-9525) Avail: NTIS (US Sales Only) HC A03/MF A01

The experimental procedures for the certification of carbon, nitrogen, and oxygen in zircaloy are described. The samples were analyzed in different laboratories using the following analytical methods: combustion, photon activation analysis, and deuteron activation analysis for carbon; reducing fusion, Kjeldahl's method, photon activation analysis, and charged particle activation analysis for nitrogen; and reducing fusion, photon activation analysis, and charged particle activation analysis for oxygen. The analytical

methods and the statistical approach used to analyze the data are presented. Two materials available as samples with different dimensions were certified: BCR Nos. 275 and 276. The certified mass fractions and the uncertainties are given. DOE

N86-30849# Oak Ridge National Lab., Tenn.
REFRACTORY ALLOY PERFORMANCE: UNRESOLVED ISSUES AND STATUS SUMMARY
W. O. Harms 1985 7 p Presented at the SP-100 Systems Selection Committee Review on Fuels and Materials Conference, Los Alamos, N. Mex., 20 Jun. 1985
(Contract DE-AC05-84OR-21400)
(DE85-014657; CONF-8506153-3) Avail: NTIS HC A02/MF A01

A report on refractory alloy performance was presented at the SP-100 Systems Selection Committee Review on Fuel and Materials Conference, Los Alamos, N.M., 20 Jun. 1985. DOE

N86-30850# Colorado School of Mines, Golden. Center for Welding Research.
MICROSTRUCTURE AND PROPERTIES OF FERROUS ALLOY WELDMENTS Progress Report, 1 Jan. 1985 - 31 Dec. 1985
D. L. Olson and D. K. Matlock 1985 70 p
(Contract DE-FG02-84ER-45066)
(DE86-008368; DOE/ER-45066/2) Avail: NTIS HC A04/MF A01

The microstructures and properties of new compositional grades of multipass austenitic weld metal for low and high temperature applications are being evaluated. Alloy modifications, which include substitutions for chromium, are being considered. Expressions for predicting as-solidified weld metal microstructures are being extended to include the effects of composition gradients. The effects of compositional and microstructural gradients on the thermal stability and mechanical properties of the modified austenitic weld metals is being evaluated in both single and multipass weldments. DOE

N86-30851# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
EFFECT OF NEUTRON IRRADIATION ON VANADIUM ALLOYS
D. N. Braski 1986 28 p Presented at the 2nd International Conference on Fusion Reactor Materials, Chicago, Ill., 13 Apr. 1986
(Contract DE-AC05-84OR-21400)
(DE86-009156; CONF-860421-18) Avail: NTIS HC A03/MF A01

Neutron-irradiated vanadium alloys were evaluated for their susceptibility to irradiation hardening, helium embrittlement, swelling, and residual radioactivity, and the results were compared with those for the austenitic and ferritic stainless steels. The VANSTAR-7 and V-15Cr-5Ti alloys showed the greatest hardening between 400 and 600(0)C while V-3Ti-1Si and V-20Ti had lower values that were comparable to those of ferritic steels. The V-15Cr-5Ti and VANSTAR-7 alloys were susceptible to helium embrittlement caused by the combination of weakened grain boundaries and irradiation-hardened grain matrices. Specimen fractures were entirely intergranular in the most severe instances of embrittlement. The V-3Ti-1Si and V-20Ti alloys were more resistant to helium embrittlement. Except for VANSTAR-7 irradiated to 40 dpa at 520(0)C, all of the vanadium alloys exhibited low swelling that was similar to the ferritic steels. Swelling was greater in specimens that were preimplanted with helium using the tritium trick. The vanadium alloys clearly exhibit lower residual radioactivity after irradiation than the ferrous alloys. DOE

N86-30852# Argonne National Lab., Ill.
OXIDATION/CORROSION BEHAVIOR OF LOW-CHROMIUM Fe-Cr-Ni ALLOYS CONTAINING ZIRCONIUM OF NIOBIUM
D. J. Baxter and K. Natesan Feb. 1986 22 p Presented at the 115th American Institute of Mining, Metallurgical and Petroleum Engineering Annual Meeting, New Orleans, La., 2 Mar. 1986
(Contract W-31-109-eng-38)
(DE86-008005; CONF-860340-1) Avail: NTIS HC A02/MF A01

Chromium is a vital constituent in many alloys and, as a general rule, at least 20 wt % Cr is required for the formation of protective scales on Fe-Cr-Ni alloys at temperatures up to 1000(0)C. However, in view of the strategic nature of Cr, it is desirable that new alloys with lower Cr contents be developed in order that the overall demand for Cr can be reduced. To address this requirement, a new series of Fe, 12% Cr, 8 to 12% Ni alloys containing Zr or Nb has been designed. Zirconium or Nb concentrations of up to 6 wt % were used to compensate for the low Cr contents, with the aim of providing oxidation/corrosion resistance comparable to that of commercial alloys containing in excess of 20% Cr. Experimental results show that at a high p/sub O2/, 1% Zr or Nb is sufficient to promote protective oxidation behavior, whereas at a low p/sub O2/, more than 3% of the quaternary addition may be required. In mixed-oxidant (O2/S2) environments, Zr and Nb reduce both scaling rates and internal penetration of aggressive elements from the exposure environments. DOE

N86-30853# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
CHLORIDE STRESS CORROSION CRACKING OF INSULATED AUSTENITIC STAINLESS STEEL: SOLAR HEATING CONSIDERATIONS
J. J. Peters and C. F. Jenkins 1986 21 p Presented at the Corrosion '86, Houston, Tex., 17 Mar. 1986
(Contract DE-AC09-76SR-00001)
(DE86-008907; DP-MS-85-2; CONF-860304-6) Avail: NTIS HC A02/MF A01

Chloride stress corrosion cracking (CSCC) of insulated pipe systems is discussed, and sources of chloride ions, moisture, and temperature increases in an industrial environment are considered. A recent CSCC failure of above-ground insulated austenitic stainless steel piping at the Department of Energy's Savannah River Plant (SRP) prompted investigation of the subject. Tests were run to establish pipe surface temperatures and temperature variations beneath thermal insulation during normal operation and under idle conditions. The effects of temperature on the pipe surface by sustained solar heating and unregulated electrical heat tracings were determined. The surface temperatures exceeded 54(0)C (130(0)F) on a sunny summer day. SRP design requires consideration of CSCC at 40(0)C (104(0)F), prompting the need for preventive methods to avoid failure above 40(0)C whenever stainless steel and chlorides occur simultaneously. Recommended preventive techniques are discussed. DOE

N86-30854# Los Alamos National Lab., N. Mex.
EVALUATION OF FACTORS AFFECTING THE ANALYSIS OF METALS USING LASER-INDUCED BREAKDOWN SPECTROSCOPY
D. A. Cremers and D. J. Romero 1986 7 p Presented at the SPIE Technical Symposium on Applications of Artificial Intelligence, Orlando, Fla., 31 Mar. 1986
(Contract W-7405-eng-36)
(DE86-008726; LA-UR-86-837; CONF-860366-4) Avail: NTIS HC A02/MF A01

Some of the main factors affecting the analysis of solid steel using laser-induced break-down spectroscopy (LIBS) have been investigated and are reported here. Pulses from an electro-optically Q-switched Nd:YAG laser were focused on steel samples to generate a high temperature plasma. The spectrally resolved plasma light was time resolved and detected using a photodiode array. The effects that changes in the lens-to-sample distance, laser pulse energy, and position of the imaging lens had on the LIBS analysis are described. These effects were minimized by ratioing the absolute element signals to adjacent Fe-lines. Calibration curves for Mn, Si, and Cr are presented and the accuracy and precision of LIBS analysis listed for several elements. DOE

N86-30855# Michigan State Univ., East Lansing. Div. of Engineering Research.
DYNAMIC RECRYSTALLIZATION DURING HIGH TEMPERATURE LOW CYCLE FATIGUE OF NICKEL Progress Report, 1 Jun. 1985 - 31 May 1986
G. Gottstein Jan. 1986 32 p
(Contract DE-FG02-85ER-45205)
(DE86-009010; DOE/ER-45205/1) Avail: NTIS HC A03/MF A01

The occurrence of dynamic recrystallization in single and

polycrystals under nonmonotonic loading conditions was investigated. Intermediate annealing, load inversion or changing the strain path facilitates dynamic recrystallization. Low cycle fatigue in the elastic regime has about the same effect as static recovery for the same time period. Invariably, the initiation of dynamic recrystallization is controlled by dynamic recovery, as indicated by a constant ratio sigma(sub R)/sigma(sub S). During low-cycle fatigue at 0.5 Tm with 1% plastic strain amplitude, dynamic recrystallization can be initiated at much lower stresses than in monotonic tests, but recrystallization progresses much more slowly. The static recrystallization behavior of rolled Ni3Al was investigated to establish the conditions for the occurrence of dynamic recrystallization in this material. DOE

N86-30856# Oak Ridge National Lab., Tenn.
MECHANICAL PROPERTY MEASUREMENTS ON ION-IRRADIATED METALS
S. J. Zinkle and W. C. Oliver 1986 22 p Presented at the 2nd International Conference on Fusion Reactor Materials (ICFRM-2), Chicago, Ill., 13 Apr. 1986
(Contract DE-AC05-84OR-21400)
(DE86-009147; CONF-860421-20) Avail: NTIS HC A02/MF A01

A recently developed mechanical microprobe (MPM) has been used to investigate strength and elastic modulus changes in ion-irradiated metals. The indenter load and its displacement are simultaneously monitored while the indentation is being made and also during unloading. Microhardness measurements have been performed on ion-irradiated copper and Cu-O.15% Zr (AMZIRC). The depth dependence of the ion damage has been investigated in selected specimens which were prepared using a cross-section technique. This procedure allows a direct comparison to be made of microhardness data from different irradiation depths while the indent size held constant. The displacement damage associated with ion irradiation caused either hardening or softening, depending on the irradiation conditions and the material. DOE

N86-30857# Hanford Engineering Development Lab., Richland, Wash.
PLASTICITY AND STRESS RELAXATION IN FRACTURE MECHANICS TEST OF COPPER AND CUPRONICKEL
L. A. James Mar. 1986 26 p
(Contract DE-AC06-76FF-02170)
(DE86-009425; HEDL-7578) Avail: NTIS HC A03/MF A01

Load relaxation tests were performed using precracked fracture mechanics specimens of annealed copper and as-received 90-10 cupronickel alloy. Test temperatures were 100(0), 150(0), and 250(0)C with, in some cases, exposure times out to 2439 hours. Significant load relaxation was noted in some cases, and the applicability of using these specimens in such cases is discussed. DOE

N86-30858# Universidade Federale do Rio de Janeiro (Brazil). Coordenacao dos Programas de Pos-Graduacao de Engenharia.
STUDY OF THE POLARIZATION FOR INCOLOY 800 AND FOR THE STAINLESS STEEL AISI 304 IN MIXTURES OF IRON, NICKEL AND CHROMIUM CHLORIDES
A. M. Travalloni, L. Sathler, and O. R. Mattos 1985 10 p In PORTUGUESE Presented at the 12th National Seminar on Corrosion, Salvador, Brazil, 13 May 1985
(DE86-701576; INIS-BR-432; CONF-8505227-3) Avail: NTIS (US Sales Only) HC A02/MF A01

Polarization curves for the Incoloy 800 and for the stainless steel AISI 304 were obtained with static and rotational electrodes. The electrolytes employed showed growing concentrations of mixtures as iron, nickel and chromium chlorides their proportion being the same as the content of these elements in the respective alloys. The alloys under investigation exhibited a continuous transition behavior from the passive to the active-passive and to the active conditions. Also, the pH was found to be the main parameter controlling the anodic behavior of the alloy. DOE

N86-30859# Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil).
EVALUATION OF THE CORROSION OF ALUMINUM TUBES UNDER CONDITIONS OF NATURAL IMMERSION IN AQUEOUS MEDIUM
M. F. de Oliveira 1985 14 p In PORTUGUESE Presented at the 12th National Seminar on Corrosion, Salvador, Brazil, 13 May 1985
(DE86-701579; INIS-BR-430; CONF-8505227-4) Avail: NTIS (US Sales Only) HC A02/MF A01

This work evaluates the corrosion of aluminum tubes under conditions of natural immersion in aqueous medium. LocaL attack was observed on the surface of the tubes for all temperatures studied. It was found that the mass fluctuation of the samples tested in deionized water at room temperatures is practically inexistent. However, at temperatures of 45 and 60(0)C the aluminum react rapidly with water forming a film of hydrated oxide of aluminum known as bayerite. It was verified that the contact of graphite and particles containing high content of Cu with aluminum forms a galvanic couple which should be avoided. DOE

N86-30860# Commission of the European Communities (Luxembourg).
PROPERTIES OF POINT DEFECTS IN METALS AND ALLOYS
W. Schuele 1984 26 p In FRENCH Prepared in cooperation with Commission of the European Communities, Ispra, Italy
(DE86-780413; EUR-9451) Avail: NTIS (US Sales Only) HC A03/MF A01

Experimental results, both old and new, are discussed and interpreted. It is shown in a straightforward way that the properties of point defects are completely different from those commonly assumed during the last 25 years. The properties of interstitials, vacancies and divacancies of some pure metals are listed and those of some alloy materials are given in the context of the paper. The corresponding radiation damage model is called the modified two-interstitial model, which develops from the two interstitial model. On the basis of the new radiation damage model structural changes observed in stainless steel alloys and the value of simulation experiments in fusion reactor technology are discussed. DOE

N86-30861# California Univ., Berkeley. Lawrence Berkeley Lab.
THEORY OF STRENGTHENING BY ORDERED PRECIPITATES
J. Glazer and J. W. Morris, Jr. Feb. 1986 18 p Presented at the International Conference on Aluminum Alloys, Charlottesville, W. Va., 15 Jun. 1986
(Contract DE-AC03-76SF-00098)
(DE86-009355; LBL-21156; CONF-8606107-1) Avail: NTIS HC A02/MF A01

A model for the critical resolved shear stress neat peak strength of alloys hardened by ordered precipitates is developed. The model is applied to the specific case of delta' precipitates in binary aluminum-lithium alloys and found to be in good quantitative agreement with measured aging behavior. The effects of precipitate size, size distribution and shape on the critical resolved shear stress are explored via the model and predictions for more optimized microstructures presented. DOE

N86-30862# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna. Inst. fuer Reaktorsicherheit.
POTASSIUM NATURAL CONVECTION LOOP HT4, OPERATING REPORT NUMBER 1
Norbert Schwarz, Hannes Himmler, Hans Lichtl, and Wolfgang Prislinger Aug. 1985 36 p In GERMAN; ENGLISH summary
(OEFZS-4329; RS-262/85; ESA-86-97067) Avail: NTIS HC A03/MF A01

Operating experience with a potassium natural convection loop is summarized. The HT4-loop was put into operation in order to investigate high temperature resistant material corrosion and boiling phenomena. The sensitivity of the flowmeter is calculated to be 0.17 mV/(l)min. The values obtained with several calibration methods strongly differ. Further temperature sensors were installed to improve this situation. The operating and data acquisition experiences over the first 3000 hr of operation at a maximum temperature of 400 C are described. ESA

N86-30863# Lehigh Univ., Bethlehem, Pa. Dept. of Metallurgy and Materials Engineering.
ANALYSIS OF THE TOUGHNESS CHARACTERISTICS OF CRYOGENIC 9% NICKEL STEELS Final Report, Jul. 1984 - Nov. 1985
R. D. Stout and S. K. Tarby Jan. 1986 37 p
(Contract GRI5080-352-0322)
(PB86-196144; GRI-86/0002) Avail: NTIS HC A03/MF A01 CSCL 11F

A statistical analysis of the Charpy notch toughness exhibited by production heats of 9% nickel steels as affected by the year of manufacture and compositional variations has been performed. Data from more than 600 heats show a notable increase in notch toughness during the past 15 years and a level of performance far superior to minimum requirements of ASTM standards. A multiple regression analysis indicated that much of the improvement has been attained by lowering the sulfur and carbon contents of the steel. The unexplained variance of notch toughness may be due to effects of heat treatment, the within-heat scatter, and composition variables that lay outside the data available for analysis. Doubling the required minimum Charpy notch toughness appears feasible without hardship to steel producers but with an enhancement of the reliability of LNG storage tanks. GRA

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N86-30864*# AiResearch Mfg. Co., Los Angeles, Calif.
SPACE STATION MOLECULAR SIEVE DEVELOPMENT Final Report
Craig Chang (Signal Research Center, Inc., Des Plaines, Ill.) and Jean Rousseau 1 May 1986 59 p
(Contract NAS8-36424)
(NASA-CR-178885; NAS 1.26:178885; Rept-86-30002) Avail: NTIS HC A04/MF A01 CSCL 07B

An essential function of a space environmental control system is the removal of carbon dioxide (CO2) from the atmosphere to control the partial pressure of this gas at levels lower than 3 mm Hg. The use of regenerable solid adsorbents for this purpose was demonstrated effectively during the Skylab mission. Earlier sorbent systems used zeolite molecular sieves. The carbon molecular sieve is a hydrophobic adsorbent with excellent potential for space station application. Although carbon molecular sieves were synthesized and investigated, these sieves were designed to simulate the sieving properties of 5A zeolite and for O2/N2 separation. This program was designed to develop hydrophobic carbon molecular sieves for CO2 removal from a space station crew environment. It is a first phase effort involved in sorbent material development and in demonstrating the utility of such a material for CO2 removal on space stations. The sieve must incorporate the following requirements: it must be hydrophobic; it must have high dynamic capacity for carbon dioxide at the low partial pressure of the space station atmosphere; and it must be chemicly stable and will not generate contaminants. B.G.

N86-30865*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
A METHOD FOR PREDICTING SERVICE LIFE OF ZINC RICH PRIMERS ON CARBON STEEL
Charles W. Hoppesch Apr. 1986 18 p
(NASA-TM-83101; NAS 1.15:83101) Avail: NTIS HC A02/MF A01 CSCL 11C

The service life of zinc rich primers on carbon steel can be estimated by immersing a primer coated glass slide into an aqueous copper sulfate solution and measuring the amount of zinc that reacts with the copper in 15 minutes. This zinc availability test was used to evaluate eleven primers currently available for which marine beach exposure data was available from previous programs. Results were evaluated and a correlation between zinc availability and ASTM rust grade was shown. Author

N86-30866# Massachusetts Univ., Amherst.
IMPROVED STRUCTURAL POLYMER ALLOYS AND COMPOSITES Final Report, 1 May 1984 - 30 Apr. 1985
Frank E. Karasz 24 Dec. 1985 18 p
(Contract F49620-84-C-0051)
(AD-A166150; UMASS-5-28246; AFOSR-86-0132TR) Avail: NTIS HC A02/MF A01 CSCL 11/9

Substantial progress was made in both experimental and theoretical elements. First, procedures were devised to synthesize: (1) sulfonated polysulfone with a controlled and reproducible structure, (2) sulfonated polyaryletheretherketone with less than 30% sulfonation that has potential as a new high-temperature ionomer, and (3) polyaryletherketone-co-ethersulfone made by a novel ether interchange. Blending studies centered on copolyester LCP's and polybenzimadazole/polyimide combinations. The latter are rendered compatible through specific interaction but which can be phased separated. This finding could result in greatly enhanced opportunities for the use of PBI resins. The major objectives with the LCP blends was to define criteria for miscibility and to improve their processability. Theoretical research was conducted on both LCP/LCP and random coil blends. Particularly important was work on the effect of sequence distribution on phase behavior in random coil blends. A model, containing an ordering parameter, successfully explained the special case of a random/alternating copolymer of the same composition. GRA

N86-30867# Virginia Polytechnic Inst. and State Univ., Blacksburg. Technical Center for Adhesion Science.
AN INTERDISCIPLINARY APPROACH TO PREDICTIVE MODELING OF STRUCTURAL ADHESIVE BONDING CHARACTERIZATION OF CHROMIC ACID AND ANODIZED Ti-6Al-4V AND ANODIZED Ti-6Al-4V SINGLE LAP BONDS TO POLYPHENYLQUINOXALINE Annual Report
Jean A. Skiles and J. P. Wightman Jan. 1986 52 p
(Contract N00014-82-K-0185)
(AD-A166313) Avail: NTIS HC A04/MF A01 CSCL 11/6

The purpose of this 1985 status report is to describe the following: (1) morphology, thickness and structure characterization of chromic acid anodized Ti-6Al-4V determined by Transmission Electron Microscopy (TEM) and Selected Area Electron Diffraction (SAED); (2) unfulled polyphenylquinoxaline (PPQ) chromic acid anodized (CAA) Ti-6Al-4V unaged single lap bond strength data; (3) unstressed thermal aging tests in progress for PPQ - CAA Ti-6Al-4V single lap bonds; and (4) tests in progress to determine the electrical properties of CAA Ti-6Al-4V. These tests will determine the anodic oxide capacitance, dielectric constant and bulk resistivity. GRA

N86-30868# Cincinnati Univ., Ohio. Dept. of Materials Science and Engineering.
PHASE RELATIONS AND MISCIBILITY IN POLYMER BLENDS CONTAINING COPOLYMERS
R. J. Roe and D. Rigby 15 Apr. 1986 82 p
(Contract N00014-85-K-0245)
(AD-A166773; TR-4) Avail: NTIS HC A05/MF A01 CSCL 07/4

This article reviews the reported work on thermodynamics of polymer blends in which at least one of the components is a copolymer. Theoretical and experimental studies of miscibility and phase transition and separation behaviors in such systems are summarized. Chapter 2 deals with blends involving random copolymers, including the cases in which a random copolymer AB is mixed with either a homopolymer A, or a homopolymer C, or two homopolymers A and B. Chapter 3 deals with blends involving a block copolymer, and after giving a brief overview of systems containing a pure block copolymer alone, it reviews the blend systems containing a block copolymer AB mixed with a homopolymer A or two homopolymers A and B. GRA

N86-30869# Illinois Univ., Urbana. Dept. of Chemistry.
NMR STUDY OF DISORDERED MATERIALS UNDER EXTREME

CONDITIONS OF PRESSURE AND TEMPERATURE Final Report, 1 Oct. 1980 - 30 Sep. 1985
Jiri Jonas 5 Feb. 1986 20 p
(Grant AF-AFOSR-0010-81)
(AD-A167063; AFOSR-86-0204TR) Avail: NTIS HC A02/MF A01 CSCL 20/2

A new nuclear magnetic resonance (NMR) method for measuring the crystallization kinetics of polymers under high pressure, sensitive on a molecular scale to the dynamics of chain motion, was developed. The very rapid formation of extended chain crystals of polyethylene was directly observed. The techniques has much promise for future experiments including polymer crystallization, melting and annealing. Polarization microscopy and NMR experiments on various alkali salts of alkalicarboxylates elucidated the dynamic structure of these interesting ionic liquid crystalline materials. Experiments on highly viscous liquids explained the origin of the anomalous discontinuity observed in the temperature dependence of the shear viscosity of glass forming liquids. Molecular level interpretation of the coupling between translational and rotational motions in viscous liquids was achieved. The Debye and Stokes-Einstein equations were found to be applicable at the molecular level in viscous liquids. Volume effects were shown to be important for dynamics of viscous liquids. GRA

N86-30870# State Univ. of New York, Buffalo. Dept. of Chemistry.
MOLECULAR MECHANICS OF SUBMICRON THIN MONOMERIC AND POLYMERIC MOLECULAR FILMS Final Report, 30 Jul. 1984 - 29 Jul. 1985
Paras N. Prasad 31 Mar. 1986 6 p
(Grant AF-AFOSR-0281-84)
(AD-A167277; AFOSR-86-0228TR) Avail: NTIS HC A02/MF A01 CSCL 11/9

This grant, through the DOD-University Instrumentation program, was provided to acquire a picosecond laser system for the study of non-linear optical effects as well as for structural characterization of submicron films. The laser system consists of a CW mode-locked Nd-Yag laser (Spectra-Physics, Model 300), the output of which, after frequency doubling, is split by a 50% beam splitter to sync pump two dye lasers (Spectra-Physics, Model 375). The outputs from these dye lasers are fed into two amplifiers (Quanta Ray, Model PDA) which are pumped by the second harmonic of a 20Hz pulsed Nd-Yag laser (Quanta-Ray, Model DCR-2A). the amplified pulses are 7ps wide with 0.5MJ of pulse energy. The laser system has proven to be extremely versatile and, therefore, valuable for a number of different experiments. This arrangement also gives us the choice to generate tunable picosecond u.v. and IR pulses by mixing either of two dye laser beams with the fundamental from the pulse Yag laser. GRA

N86-30871# Rockwell International Corp., Thousand Oaks, Calif. Science Center.
LIFETIME PREDICTION OF ORGANIC COATING/METAL SYSTEMS Final Report, 1 Jul. 1979 - 31 Oct. 1985
F. Mansfeld and M. Kendig Apr. 1986 97 p
(Contract N00014-79-C-0437)
(AD-A167281; SC5222.FR) Avail: NTIS HC A05/MF A01 CSCL 11/3

A lifetime prediction model has been developed for polymer coating/metal systems. The elements of the model fall into the category of system variables that describe the surface of the substrate, the coating or the environment, or the category of processes that determine the degradation of the coated metal. These processes include formation of defects in the coating and at the metal/coating interface, transport of corrosive species to the metal, loss of adhesion, corrosion and failure. The casual relationship between system variables and processes has been discussed. The lifetime prediction model is based on a series of experimental studies which have been performed during the course of this project. A number of new techniques have been developed which can be used to determine the properties of the coating/metal compound and its changes during interaction with corrosive environments. Electrochemical impedance spectroscopy (EIS) has been found to be very valuable in providing information concerning the coating and the metal surface and degradation of the coatings as corrosion proceeds. An acoustic pulse technique has been used to detect areas of delamination and corrosion. Acoustic emission from coated steel during straining of the sample has provided characteristic fingerprints for surface and coating properties and has demonstrated the importance of the mechanical properties of the coating. GRA

N86-30872# Lawrence Livermore National Lab., Calif.
ASSESSMENT OF THE APPLICATION OF THE SPUTTERING PROCESS TO BERYLLIUM FOR HARDENING OPTICAL COATINGS
C. W. Chen and C. S. Alford 11 Nov. 1985 13 p
(Contract W-7405-eng-48)
(DE86-006656; UCID-20601) Avail: NTIS HC A02/MF A01

Two principal deposition processes are compared for the case of depositing 1 to 2 microns beryllium on fused-silica substrates. While the evaporation-deposition process offers advantages such as higher deposition rate, purification of the evaporant and efficient use of masks, the sputter-deposition is more versatile, and therefore more effective, in varying and controlling the microstructure of the deposits. The versatility comes about because the latter process has five major operational parameters to be selected or adjusted. Consequently, sputter-deposited beryllium films are expected to display more desirable microstructures and better surface finish than evaporation-deposited films. DOE

N86-30873# Oak Ridge National Lab., Tenn.
CORROSION OF SiC CERAMICS IN SYNTHETIC COMBUSTION ATMOSPHERES CONTAINING HALIDES
J. I. Federer, J. M. Robbins, P. J. Jones, and C. Hamby, Jr. Dec. 1985 27 p
(Contract DE-AC05-84OR-21400)
(DE86-006732; ORNL-6258) Avail: NTIS HC A03/MF A01

Corrosion of SiC ceramics has occurred in several industrial furnace environments. Halides derived from fluxes in aluminum remelt furnaces have been suspected to be responsible for corrosion in those furnaces. The present work involved exposure of SiC ceramics to synthetic combustion atmospheres (SCA) in laboratory furnaces to determine if halide species cause corrosion and, if so, to determine the corrosion mechanism. Specimens were exposed to SCA containing HCl, NaCl, and NaF at 1200 C for approximately 1000 h each. Exposure to SCA-HCl resulted only in small weight and dimensional increases similar to those occurring during air oxidation. However, exposure to SCA-NaCl and SCA-NaF resulted in significant corrosion characterized by weight losses and formation of glassy coatings. The coatings, which consisted mainly of SiO2, also contained Na2O and other metallic oxides. The Si content of SiC lost by corrosion far exceeded the Si content of the coatings, which suggested that other Si species formed during corrosion. The corrosion mechanism inferred from the results and from thermodynamic free energies of reaction involves formation of volatile Si halides. Direct evidence for formation of Si halides, however, was not found. Flexure strengths at 1100 C (with corrosion products intact) were not significantly decreased relative to unexposed specimens. In fact, strengths increased in some cases even though tensile surfaces were roughened by corrosion. DOE

N86-30874# Schott Glass Technologies, Inc., Duryea, Pa.
MEGAJOULE LASER GLASS DEVELOPMENT Final Status Report
L. M. Cook Aug. 1985 14 p
(Contract W-7405-eng-48)
(DE86-006731; UCRL-15713) Avail: NTIS HC A02/MF A01

Various compositions of glass for use in a megajoule laser are examined. The desired properties are a high fluorescence lifetime at approx. 5 x 10(20) ions/cm(3), a cross section less than or equal to 3.0, and melting characteristics comparable with the semi-continuous phosphate melting system being designed. In

addition, efforts are reported for attempts to improve thermal shock and concentration quenching. DOE

N86-30875# Lawrence Livermore National Lab., Calif.
PLATINUM PARTICLES IN THE Nd:DOPED DISKS OF PHOSPHATE GLASS IN THE NOVA LASER
D. Milam, C. W. Hatcher, and J. H. Campbell 20 Feb. 1986 19 p Presented at the Boulder Damage Symposium, Boulder, Colo., 15 Oct. 1985
(Contract W-7405-eng-48)
(DE86-007119; UCRL-93253; CONF-8510101-6) Avail: NTIS HC A02/MF A01

The disks of Nd:doped phosphate glass in the amplifiers of the Nova laser contain platinum particles with sizes ranging from less than 5 (MU)m (detection limit) to about 100 (MU)m. The particle density varies from about 0.01 to 1.0 cm(-3). These particles cause fractures when irradiated at fluences greater than 2.5 J/cm(2) delivered in 1-ns, 1054-nm pulses. Under repeated irradiation at 5 to 7 J/cm(2), damage from small (less than 5 (MU)m) particles asymptotically approaches a limiting size, but damage surrounding the larger particles grows steadily. The damage threshold fluence, 2.5 J/cm(2), corresponds to operation of Nova at one-half the desired output for pulse durations longer than 1 nsec. Operation at higher fluences causes accumulation of damage in the output amplifiers and requires replacement of the disks in those amplifiers on an accelerated schedule. DOE

N86-30876# Sandia National Labs., Albuquerque, N. Mex.
EFFECT OF SURFACE CORROSION ON GLASS FRACTURE
B. C. Bunker and T. A. Michalske 1985 21 p Presented at the 4th International Symposium on the Fracture Mechanics of Ceramics, Blacksburg, Va., 8 Jun. 1985
(Contract DE-AC04-76DP-00789)
(DE86-008404; SAND-86-0582C; CONF-8506128-4) Avail: NTIS HC A02/MF A01

The nature of aqueous corrosion reactions on glass surfaces varies with glass composition and environmental conditions. We have shown how the physical effects of the various surface reactions can be incorporated into simple fracture mechanics models to predict measured crack velocity effects in silicate glasses. Reactions on glass surfaces are divided into four categories; bond rupture reactions, alteration layer formation, surface deposition, and intermolecular surface forces. These results demonstrate the effect of chemical reaction mechanisms on the long-term mechanical behavior of glasses. DOE

N86-30877# Air Force Weapons Lab., Kirtland AFB, N. Mex.
RAMAN SCATTERING ANALYSIS OF THIN-FILM COATINGS USING GUIDED WAVES
Alan F. Stewart, David R. Tallant (Sandia National Labs., Albuquerque, N. Mex.), and K. L. Higgins 1985 20 p Presented at the 17th Annual Symposium on Optical Materials for High-power Lasers, Boulder, Colo., 28 Oct. 1985 Prepared in cooperation with Air Force Weapons Lab., Kirtland AFB, N.M.
(Contract DE-AC04-76DP-00789)
(DE86-008776; SAND-85-2076C; CONF-851052-5) Avail: NTIS HC A02/MF A01

Selected refractory-oxide, thin-film coatings were analyzed using Raman spectroscopy. Diamond and rutile prisms were used to couple the probe beam into the thin-film coatings which served as waveguides. Propagation of the probe beam as a guided wave in the thin film increases the probability for Raman scattering by species in the thin film compared to techniques which depend on a single pass through or probe beam reflection at the film. Because the probe beam is confined entirely within the thin-film coating, Raman spectra are obtained which are generally free of vibrational bands due to the substrate. The combination of of more efficient coupling between the probe beam and the thin film and the elimination of substrate interferences results in improved sensitivity and the ability to record recognizable Raman spectra of thin films composed even of materials that are relatively inefficient Raman scatters. DOE

N86-30878# Technical Research Centre of Finland, Espoo.
JOINING OF CERAMICS FOR HIGH TEMPERATURE APPLICATIONS
M. Vilpas Aug. 1985 37 p In FINNISH
(DE86-751572; VTT-TIED-481) Avail: NTIS (US Sales Only) HC A03/MF A01

The report summarizes a literature survey of the methods for joining ceramics to ceramics or ceramics to metals for high temperature applications. Also mechanical properties and potential applications of the joints are considered. The joining of ceramics is usually carried out by brazing or diffusion bonding. Especially the letter has been found useful and increased the applications of joined ceramics. Recently also the possibilities to use electron beam and laser beam welding for joining of ceramics have been investigated. The joining of ceramics has found numerous applications, typical for high operating temperatures being different sensors and thermocouples. DOE

N86-30879# Florida Univ., Gainesville. Dept. of Materials Science and Engineering.
WETTING AND DISPERSION IN CERAMIC/POLYMER MELT INJECTION MOLDING SYSTEMS
M. D. Sacks, J. W. Williams, and C. D. Batich Nov. 1985 11 p
(Contract DE-FG05-85ER-45202)
(DE86-009001; DOE/ER-45202/1) Avail: NTIS HC A02/MF A01

The major goal of this program is to achieve an improved understanding of the factors influencing dispersion of ceramic particles in polymer melts. In general, there are three requirements in the dispersion of a powder in a liquid medium (e.g., a polymer melt): (1) wetting of the powder by the liquid; (2) breaking up powder agglomerates; and (3) maintaining the dispersed state (e.g., avoiding particle coagulation). Work has been initiated in each of these areas. Preliminary results are described. DOE

N86-30880# Allied Bendix Corp., Kansas City, Mo.
STRESS RELAXATION OF CELLULAR SILICONE MATERIAL: 1984
J. W. Schneider Mar. 1986 22 p
(Contract DE-AC04-76DP-00613)
(DE86-009131; BDX-613-3420) Avail: NTIS HC A02/MF A01

The long-term (10 years) stress relaxation properties of cellular silicone materials at room temperature are under evaluation. Both equilibrium (random copolymer) and condensation (block copolymer) type base polymers are included. The equilibrium-type material used urea as the leachable filler, and the condensation-type material used ammonium chloride. Each material was compounded to yield densities of 0.34 and 0.52 g/cm(3) for thicknesses of 1.17, 1.52, and 2.54 mm. These density-thickness combinations were compressed to nominal compressions of 20 and 40% with nine replicates at each condition. A specially designed fixture was used to maintain a specific compression on the cellular sample, and a universal test machine acquired the load data. Currently, the predicted load retention is between 60 and 68% of the original load. DOE

N86-30881# Oak Ridge National Lab., Tenn.
NEEDS ASSESSMENT FOR NONDESTRUCTIVE TESTING AND MATERIALS CHARACTERIZATION FOR IMPROVED RELIABILITY IN STRUCTURAL CERAMICS FOR HEAT ENGINES
D. R. Johnson, R. W. McClung, M. A. Janney, and W. M. Hanusiak 1986 8 p Presented at the 2nd International Symposium on Ceramic Materials and Components for Engines, Luebeck-Travemuende, West Germany, 14 Apr. 1986
(Contract DE-AC05-84OR-21400)
(DE86-010039; CONF-860413-2) Avail: NTIS HC A02/MF A01

A general ceramic processing flowsheet and inspections at each stage of the flowsheet are shown. The inspections shown identified as potentially important from the point of view of the development of highly reliable ceramics. The inspections shown were all considered in the assessment of the relative priorities for development of inspection techniques. It is anticipated that a limited number of key inspections will be identified for any given product

line. This paper reviews the status and needs for inspections in raw materials, green bodies, and dense ceramics. DOE

N86-30882# National Bureau of Standards, Gaithersburg, Md. Inst. for Materials Science and Engineering.
INSTITUTE FOR MATERIALS SCIENCE AND ENGINEERING, CERAMICS: TECHNICAL ACTIVITIES, 1985
S. M. Hsu and C. R. Hubbard Feb. 1986 81 p
(PB86-196771; NBSIR-85/3188) Avail: NTIS HC A05/MF A01 CSCL 11B

The report of the Institute for Materials Science and Engineering, Ceramics: Technical Activities 1985, contains the following: Properties/performance, Mechanical properties; Glass and composites; Tribology; Optical properties; Structure/stability-High temperature chemistry; structural chemistry; Ceramic powder characterization; Surface chemistry and bioprocesses; Processing-Structural science; and Ceramic chemistry. GRA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N86-30883# Federal Aviation Agency, Atlantic City, N.J. Technical Center.
ANTIMISTING FUEL RESEARCH AND DEVELOPMENT FOR COMMERCIAL AIRCRAFT Final Report
Michael Yaffee Apr. 1986 78 p
(FAA/CT-86/7) Avail: NTIS HC A05/MF A01

This report covers the research, development, testing, and evaluation conducted by the Federal Aviation Administration (FAA) in pursuit of an effective, feasible antimisting agent for kerosene jet fuels that would prevent or reduce the dangers of postcrash, fuel mist fires. For the past eight years, most of this effort was focused on a high molecular weight polymer, FM-9 (Trademark), as a representative agent to prove the antimisting fuel concept. The results of this work indicate that the goal is achievable: Jet fuel can be modified to provide a significant degree of protection against postcrash fires in impact-survivable accidents. Additional development and testing would be required before the fuel is operationally acceptable. It would be necessary to make some modifications in fuel handling procedures and hardware in aircraft and at airports. But there appear to be no technically insurmountable problems. Author

N86-30884# Ballistic Research Labs., Aberdeen Proving Ground, Md.
REVIEW ON COMPRESSION IGNITION SENSITIVITY STUDIES OF LIQUID GUN PROPELLANTS
John D. Knapton and Eberhard Schmolinske Mar. 1986 31 p
(AD-A165969; BRL-MR-3497) Avail: NTIS HC A03/MF A01 CSCL 21/2

Most of the past work on the compression ignition sensitivity of liquid gun propellants did not succeed in elucidating the fundamental processes involved in compression ignition. Existing theoretical predictions rely on simplifying assumptions and remain unvalidated until appropriate experimental investigations are made. Recent experimental studies have focused on safety aspects and have tried to define reaction limits based on the ullage present, the bubble size, and the pressurization rate resulting in go or no-go type of tests. Many of the tests have revealed, for cases where a compression ignition event was observed, a finite induction time before there is a significant pressure generation. There are five theoretical mechanisms (hot spot, impact (micro-jetting), chemical, cooperative effects, and oscillations) which may be involved during the ignition of a pressurized bubbly Lp and it is difficult to say which is the right one. Moreover, if one succeeds in discovering the mechanisms for ignition, adiabatic compression could be considered as a practical ignition source for a liquid propellant gun. Another important unknown in all of the adiabatic compression tests conducted to-date is the amount of dissolved gas in the propellant. For future tests, therefore, gas solubility measurements should be considered. GRA

N86-30885# Air Force Rocket Propulsion Lab., Edwards AFB, Calif.
DESCRIPTIVE CHARACTERIZATION OF SOLID INGREDIENTS Interim Report, Oct. 1984 - Feb. 1986
K. G. Chandler and P. C. Trulove Mar. 1986 17 p
(AD-A166874; AFRPL-TR-86-016) Avail: NTIS HC A02/MF A01 CSCL 21/9

Presently weight median diameter measurements are used to correlate oxidizer particle size to ballistic performance in solid propellants. Propellant burning is a heterogenous process that is greatly influenced by available surface area of oxidizer particles. Weight median diameter measurements do not accurately reflect the available oxidizer surface area so there are inherent errors in burn rate correlations. This study focuses on the development of a new oxidizer particle characterization technique that is surface dependent to improve accuracy in correlating oxidizer particles to ballistic performance. Author (GRA)

N86-30886# Technical Research Centre of Finland, Espoo.
VEGETABLE OILS AS DIESEL FUELS. REDUCTION OF CARBON FOULING
M. Kytoe, N. O. Nylund, and K. Sipilae Jun. 1985 44 p In FINNISH; ENGLISH summary
(DE86-750610; VTT-TIED-464) Avail: NTIS (US Sales Only) HC A03/MF A01

It is accepted that vegetable oil is fairly well suited as fuel for diesel engines in short-term use. Good results have also been obtained in long-term experiments with precombustion chamber diesels. In direct-injection diesel engines heavy carbon fouling often causes problems. In the experimental part of the research work the ability of certain additives to reduce fouling was studied on a direct-injection Petter AVB engine in a 20 h test. A mixture consisting of 50% diesel oil and 50% alkali refined rape oil was used as the fuel. Additives rated effective according to literature references did not reduce fouling in these experiments, whereas fairly good results were obtained using an ignition improver. DOE

N86-30887# Retallick (William B.), West Chester, Pa.
HYDROGEN STORAGE SYSTEM Interim Report
W. B. Retallick 18 Feb. 1986 8 p
(Contract DE-FG01-85CE-15230)
(DE86-006990; DOE/CE-15230/T1) Avail: NTIS HC A02/MF A01

Hydrogen can be stored in the form of a metal hydride. The formation of the hydride is highly exothermic. Hence the rate at which hydrogen can be added to or removed from the storage system is limited by the rate of heat transfer. Heat transfer is facilitated by displaying the hydride on a metal support that conducts heat. The task was to find a binder to make hydride stay put on a metal support through at least 250(0) cycles of hydriding-dehydriding and to measure the rate of hydrogen uptake. DOE

N86-30888# Sandia National Labs., Albuquerque, N. Mex.
ELECTRONIC SIMULATOR AND CALIBRATOR FOR ELECTROTHERMAL RESPONSE TEST SYSTEMS
Larry M. Moore, Arnold C. Strasburg, and James J. Spates (Ktech Corp., Albuquerque, N. Mex.) Feb. 1986 26 p
(Contract DE-AC04-76DP-00789)
(DE86-008874; SAND-85-2259) Avail: NTIS HC A03/MF A01

The electrothermal response (ETR) test is performed on electroexplosive devices (EED). A device is described which simulates these EED's. The simulator generates a voltage analog which varies exponentially with time and has an amplitude which is proportional to the third power of the input current. This exponential response is superimposed on a square wave analog which simulates the constant voltage drop across the cold

resistance of a bridgewire. Also described is a calibrator for ETR testers. The calibrator generates a known change in resistance for determining the response of a system under test. DOE

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N86-30889*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
JPL PREFERRED PARTS LIST: RELIABLE ELECTRONIC COMPONENTS
Robert E. Covey, W. Richard Scott, Lawrence M. Hess, T. George Steffy, and Frank R. Stott 20 Jul. 1982 290 p
(Contract NAS7-918)
(NASA-CR-176258; NAS 1.26:176258; NPO-16028/5821) Avail: NTIS HC A13/MF A01 CSCL 13B

The JPL Preferred Parts List was prepared to provide a basis for selection of electronic parts for JPL spacecraft programs. Supporting tests for the listed parts were designed to comply with specific spacecraft environmental requirements. The list tabulates the electronic, magnetic, and electromechanical parts applicable to all JPL electronic equipment wherein reliability is a major concern. The parts listed are revelant to equipment supplied by subcontractors as well as fabricated at the laboratory. B.G.

N86-30890# New Mexico Univ., Albuquerque. Engineering Research Inst.
FIRE EXTINGUISHING AGENTS FOR OXYGEN-ENRICHED ATMOSPHERES Final Report, 1 Apr. 1982 - 30 Nov. 1985
Martin A. Plugge, Christopher W. Wilson, Dennis M. Zallen, and Joseph L. Walker Dec. 1985 98 p
(Contract F29601-81-C-0013)
(AD-A166967; NMERI-TA3-19; ESL-TR-85-26) Avail: NTIS HC A05/MF A01 CSCL 13/12

Fire-suppression agent requirements for extinguishing fires in oxygen-enriched atmospheres were determined employing small-, medium-, large-, and full-scale test apparatuses. The small- and medium-scale tests showed that a doubling of the oxygen concentration required five times more HALON for extinguishment. For fires of similar size and intensity, the effect of oxygen enrichment of the diluent volume in the HC-131A was not as grate as in the smaller compartments of the B-52 which presented a higher damage scenario. The full-scale tests showed that damage to the airframe was as important a factor in extinguishment as oxygen enrichment. GRA

N86-31425*# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Electrical Engineering.
ENGINEERING GRAPHICS DATA ENTRY FOR SPACE STATION DATA BASE
R. C. Lacovara *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 13 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 13B

N86-30792# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France).
COMPARISON OF CLASSICAL AND COCURING MANUFACTURING TECHNIQUES FOR A CFRP HONEYCOMB CENTRAL TUBE
J. L. Pettex *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 291-294 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

N86-30891*# Massachusetts Univ., Amherst. Dept. of Electrical and Computer Engineering.
NEAR MILLIMETER WAVE IMAGING/MULTI-BEAM INTEGRATED ANTENNAS Technical Report, 1 Oct. 1985 - 31 Mar. 1986
K. Sigfrid Yngvesson 1986 71 p
(Grant NAG1-279)
(NASA-CR-176989; NAS 1.26:176989) Avail: NTIS HC A04/MF A01 CSCL 20N

Theoretical models of single element Linearly Tapered Slot Antennas (LTSA) and coupling effects of LTSA arrays are discussed. A list of publications is given. For individual titles, see N86-30892 through N86-30893.

N86-30892*# Massachusetts Univ., Amherst.
THEORETICAL MODELS OF SINGLE-ELEMENT LTSA ANTENNA ELEMENTS
In its Near Millimeter Wave Imaging/Multi-Beam Integrated Antennas 1986 53 p (For primary document see N86-30891 22-32)
Avail: NTIS HC A04/MF A01 CSCL 20N

The spectral domain computations for slotline guide wavelength and characteristic impedance provide the basic parameters that are need to calculate the radiation pattern of an Linearly Tapered Slot Antenna (LTSA) by using the half-plane Green's function and a stepped approximation to the LTSA structure. However, the spectral domain computations are somewhat time consuming and not suitable for computer aided design application. Therefore, the results of several computation were fitted by formulas that are readily evaluated on a calculator or computer. Antenna measurements were continued, and an attempt was made to predict the truncation effect by three different methods. B.G.

N86-30893*# Massachusetts Univ., Amherst. Dept. of Electrical and Computer Engineering.
CHARACTERISTIC IMPEDANCE OF A WIDE SLOT LINE ON LOW PERMITTIVITY SUBSTRATES
R. Janaswamy and D. H. Schaubert *In its* Near Millimeter Wave Imaging/Multi-Beam Integrated Antennas 1986 15 p (For primary document see N86-30891 22-32)
Avail: NTIS HC A04/MF A01 CSCL 20N

Computed results on the characteristics impedance of wide slots etched on an electrically thin substrate of low dielectric constant epsilon sub r are presented. These results are used to help provide design data for slotlines. Curves are presented for epsilon sub r = 2.22, 3.0, 3.8, and 9.8. Comparison is shown for the characteristic impedance between the present calculations and those available in the literature for high-epsilon sub r substrates. Empirical formulas, based on least square curve fitting, are presented for the normalized slot wavelength lambda prime/lambda sub 0 and the characteristic impedance Z sub 0 over the range: 0.0015 is equal to or less than W/lambda sub 0 equal to or less than 1.0, 0.006 is equal to or less than d/lambda sub 0 equal to or less than 0.06, 2.22 is equal to or less than epsilon sub 0 equal to or less than 9.8. Author

N86-30894# Selenia Industrie Associate S.p.A., Rome (Italy).
RIVISTA TECNICA SELENIA, VOLUME 9, NUMBER 4
1985 49 p
(ESA-86-97244) Avail: NTIS HC A03/MF A01

Application of number theory to high speed radar signal processing; multistatic detection of radar, signals for Swerling models of the target, magnetostatic wave applications to microwave analog signal processing; and an example of integrated logistic

support applied to production testing are discussed. For individual titles, see N86-30895 through N86-30898. ESA

N86-30895# Selenia Industrie Associate S.p.A., Rome (Italy). Signal Processing Dept.
NUMBER THEORY: A PROPOSAL FOR HIGH SPEED PROCESSORS
Tullio Bucciarelli and Carlo Conti *In its* Rivista Tecnica Selenia, v. 9, no. 4 1985 p 1-10 (For primary document see N86-30894 22-32)
Avail: NTIS HC A03/MF A01

Use of number theory for real time, high speed processing of radar signals is discussed. Number theory can be applied to optimize parallel channel processing, by which sampling times less than 50 nsecs may be achieved. The mainstays of number theory such as consistency and representation, are outlined. The ways in which such theory may be applied to transverse filtering are shown and limits are discussed. ESA

N86-30896# Selenia Industrie Associate S.p.A., Rome (Italy). Radar Dept.
MULTISTATIC DETECTION OF RADAR SIGNALS FOR SWERLING MODELS OF THE TARGET
Egido DAddio, Alfonso Farina (Naples Univ., Italy), Ernesto Conte, and Maurizio Longo *In its* Rivista Tecnica Selenia, v. 9, no. 4, 1985 p 11-17 (For primary document see N86-30894 22-32)
Avail: NTIS HC A03/MF A01

Optimum detection of radar signals by a multistatic configuration of sensors is discussed. Starting from the case of multiple observations, a systematic analysis of the model leads to a unified optimum receiver for signals fluctuating according to Swerling models 1 to 4. Suboptimum solutions through which considerable streamlining of processing structures can be achieved are found. ESA

N86-30897# Selenia Industrie Associate S.p.A., Rome (Italy). Search Dept.
MAGNETOSTATIC WAVE APPLICATION TO MICROWAVE ANALOG SIGNAL PROCESSING
Paolo DeGasperis (Consiglio Nazionale delle Ricerche, Rome, Italy), Carlo DiGregorio, Giuseppe Miccoli, and Riccardo Roveda *In its* Rivista Tecnica Selenia, v. 9, no. 4, 1985 p 18-25 (For primary document see N86-30894 22-32)
Avail: NTIS HC A03/MF A01

The physical principles underlying the operation of magnetostatic wave (MSW) devices are presented, and developments and applications are outlined. The technique promises direct handling at microwave frequencies (0.5 to 20 GHz) thanks to the control of the propagation of MSW in thin magnetic garnet films grown by liquid phase epitaxy. ESA

N86-30898# Selenia Industrie Associate S.p.A., Rome (Italy). Engineering Support Dept.
AN EXAMPLE OF INTEGRATED LOGISTIC SUPPORT APPLIED ALSO TO PRODUCTION TESTING
Vincenzo Buontempo *In its* Rivista Tecnica Selenia, v. 9, no. 4, 1985 p 26-45 (For primary document see N86-30894 22-32)
Avail: NTIS HC A03/MF A01

The basic concepts of an aerospace industry integrated logistic support plan are presented. An example shows that as well as achieving overall economy on system life cycle support cost, it reduces production costs by designing support means and production test in harmony with the logistic support means. A life cycle computation model related to the logistic support is provided. The model is also applicable to on board avionic systems such as Tornado and AMX aircraft and EH 101 helicopter. ESA

N86-30899# Computer Sciences Corp., Falls Church, Va. Systems Div.
CSC METEOR BURST MODEL ENHANCEMENT TEST REPORT Interim Report, Apr. 1985 - Feb. 1986
W. Steffancin and D. Brown Feb. 1986 51 p
(Contract DCA100-84-C-0030)
(AD-A165993) Avail: NTIS HC A04/MF A01 CSCL 17/2

This report describes enhancements made to the CSC meteor burst model in 1985 and presents and analyzes the effects of the enhancements on model results. The enhancements made include the effects of: overdense bursts, transverse resonance, burst formation, atmospheric refraction, ionospheric absorption, shower meteors and the earth's gravitational effect on meteor radiants. GRA

N86-30900# Army Military Personnel Center, Alexandria, Va.
A GaAs BASED DIGITAL SERIAL COMMUNICATIONS SYSTEM Final Report
Ramon Zulaybar delRosario 25 Mar. 1986 106 p
(AD-A166060) Avail: NTIS HC A06/MF A01 CSCL 17/2

Described are the design and simulation of a one gigabit per second synchronous transmitter and receiver system. The circuitry is to be integrated on a 32-pin gallium arsenide semicustom digital gate array. Digital logic components are built using enhancement and depletion mode n-channel metal-semiconductor field-effect transistors. The computer simulations indicate that, under a one micron gate process technology and using a 2V voltage supply, inverter propagation delays as small as 60 picoseconds can be achieved. Designs for both the transmitter and the receiver have been successfully simulated at the one gigahertz clock rate. GRA

N86-30901# Army Missile Command, Redstone Arsenal, Ala. Advanced Sensors Directorate.
THE TECHNICAL COOPERATION PROGRAM SUBGROUP K PANEL PRESENTATIONS
E. M. Holliday Sep. 1985 32 p
(AD-A166407; AD-E950826; AMSMI/RE-85-24-TR) Avail: NTIS HC A03/MF A01 CSCL 17/9

Two topics presented at recent annual meetings of The Technical Cooperation Program (TTCP), Subgroup K, are documented and discuss accomplishments and theory of group complementary coding for pulse compression in a radar system. Author (GRA)

N86-30902# Naval Weapons Center, China Lake, Calif.
NEAR-FIELD VECTOR POTENTIALS FOR THIN DIPOLE ANTENNAS Interim Report, Oct. 1984 - Sep. 1985
P. L. Overfelt Sep. 1985 20 p
(AD-A166542; AD-E900544; NWC-TP-6645) Avail: NTIS HC A02/MF A01 CSCL 20/14

A general method for exact integration of vector potentials of thin dipole antennas characterized by various current distributions is developed. Such solutions are shown to be independent of the usual far-field restrictions involving dipole length, observation point distance, and wavelength. Their convergence is rapid in the induction and near-field regions. GRA

N86-30903# Naval Underwater Systems Center, New London, Conn.
COMPARISONS OF 76Hz TRANSVERSE AND RADIAL MAGNETIC FIELD STRENGTH COMPONENTS RECEIVED IN CONNECTICUT
Peter R. Bannister 11 Mar. 1986 145 p
(AD-A166548; NUSC-TD-7523) Avail: NTIS HC A07/MF A01 CSCL 20/14

Since June 1970, we have made extremely low frequency (ELF) measurements of the transverse horizontal magnetic field strength, H sub phi, received in Connecticut. Occasionally, we also have measured either the vertical electric field strength, E sub v, or the radial horizontal magnetic field strength, H sub rho. The AN/BSR-1 ELF receivers are located at the Naval Underwater Systems Center (NUSC), at New London, CT. The transmission source for these farfield (1.6-Mm range) measurements is the U.S. Navy's ELF Wisconsin Test Facility (WTF), located in the Chequamegon National Forest in north-central Wisconsin. The results of 136 days of radial magnetic field measurements taken from November 1977 through June 1984 are discussed in this report. The main result is that during disturbed propagation conditions, the radial and transverse magnetic field strength daily

plots (versus GMT) are usually dissimilar (in both amplitude and relative phase). GRA

N86-30904# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
INTERSATELLITE LINK DESIGN ISSUES M.S. Thesis
Richard S. Fuhrmann 1985 112 p
(AD-A166761; AFIT/CI/NR-86-43T) Avail: NTIS HC A06/MF A01 CSCL 17/2

An intersatellite link is a communications link that directly connects two separate satellites. One satellite could have several links to numerous other satellites. In some of the literature, ISLs have also been called crosslinks. The first Intersatellite Link (ISL) was demonstrated by radio amateurs in 1975. The National Aeronautics and Space Administration (NASA) pursued testing that same year. NASA established links between satellites then in orbit. Sponsored by the U.S. Air Force and Navy, Lincoln Experimental Satellites (LES) 8 and 9 were launched in 1976 and established the technical feasibility of ISLs. This thesis explores some of the major design issues involved in ISLs. Two basic approaches are considered, millimeter wave (MMW) and optical. For the MMW approach, the design issues covered were frequency, antenna positioning, acquisition and tracking, antenna type, power amplification, and link analysis. For the optical approach, the design issues covered were laser source selection, optical detection, tracking and acquisition, and proposed systems. Trade-offs involved in system design were analyzed and possible applications of ISLs discussed. GRA

N86-30905# Mitre Corp., Bedford, Mass.
ADVANCED ARCHITECTURES FOR DIGITAL SIGNAL PROCESSORS Final Report, Oct. 1983 - Oct. 1984
A. L. Bequillard, D. O. Carhoun, and W. L. Eastman Oct. 1985 172 p
(Contract F19628-84-C-0001)
(AD-A166921; MTR-9647; RADC-TR-85-203) Avail: NTIS HC A08/MF A01 CSCL 09/2

This report is concerned with the development and application of improved techniques for digital signal processing, based on use of residue number system (RNS) to implement the processing functions associated with isolated-word speech recognition. Specifically, the use of RNS in combination and systolic architectures for implementation of speech recognition algorithms was explored. The implementation of time-warping speech algorithm in RNS is described. GRA

N86-30906# Naval Ocean Systems Center, San Diego, Calif.
A LOW-DATA-RATE VOICE TRANSMISSION SYSTEM (LDRVTS) FOR HF COMMUNICATION Final Report, Oct. 1980 - Sep. 1984
G. B. Johnson Sep. 1985 78 p
(AD-A166946; NOSC/TR-1103) Avail: NTIS HC A05/MF A01 CSCL 17/2

This report details the present capabilities of speech recognition and synthesis systems in relation to Marine Corps field HF-communication problems. Work includes the design and testing of a battery-powered, field version of a low-data-rate voice transmission system. GRA

N86-30907# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
A MODIFICATION OF THE H-133 GROUND COMMUNICATIONS HEADSET FOR USE IN INTENSE NOISE ENVIRONMENTS
Charles W. Nixon and Henry C. Sommer 7 Mar. 1986 31 p
(AD-A166981; AAMRL-TR-86-009) Avail: NTIS HC A03/MF A01 CSCL 17/2

Detailed technical information and instructions are provided for a simple modification of the Air Force standard H-133 ground communications headset for use in intense noise environments at levels of 135 db (SPL) and higher. This modification involves the replacement of the conventional H-136 earphone with a miniaturized receiver mounted on a custom molded insert earplug. An adaptor box-line potentiometer is fabricated to provide manual control of the level of the speech signal at the ear of the wearer. The modified H-133 communications headset has been utilized at selected Air Force bases by ground maintenance personnel who rate the hearing protection and voice communications performance as excellent. GRA

N86-30908# Mitre Corp., Bedford, Mass.
MONOPOLE ELEMENT AT THE CENTER OF A CIRCULAR GROUNDPLANE OF ARBITRARY RADIUS. VOLUME 1: THEORY AND RESULTS Final Report
M. M. Weiner, S. P. Cruze, C. C. Li, and W. J. Wilson Mar. 1986 136 p
(Contract F19628-84-C-0001)
(AD-A166991; MTR-9622-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 20/14

The Air Force SINCGARS VHF-FM radio is a frequency-hopping anti-jam device utilizing electrically short antenna to minimize aerodynamic drag on airborne platforms. The development of optimally efficient, electronically tuneable antennas for this radio is of interest. Although the antenna groundplane is platform-dependent, it is usually small compared to an rf wavelength. A circular groundplane provides a standardized geometry with which to model and evaluate candidate antennas. Accordingly, a VHF antenna range with an 8 ft. diameter circular groundplane has been constructed to evaluate candidate antennas. The electrical properties of a monopole element at the center of a circular groundplane of finite radius are of interest to this program for (1) qualifying the antenna range; (2) establishing antenna standards with which to measure test antennas; and (3) modeling candidate antennas. A survey of the literature revealed that although this antenna has the simplest geometry of any monopole antenna, its properties are neither well understood nor standardized, particularly for groundplane radii which are small or comparable to a wavelength. This paper attempts to address this deficiency.
Author (GRA)

N86-30909# SRI International Corp., Menlo Park, Calif.
STRIATION EFFECT ON HF SIGNALS Technical Report, 8 Sep. 1983 - 8 May 1984
Gary H. Price 1 Jun. 1985 41 p
(Contract DNA001-83-C-0413; DNA Proj. S99-QMXB)
(AD-A167017; DNA-TR-85-250) Avail: NTIS HC A03/MF A01 CSCL 20/14

Methods are described for calculating the effects of forward scatter by ionospheric irregularities on high-frequency sky-wave radio signals. The approach combines the forward-scatter theory (developed to treat refracted-ray paths in the context of acoustic propagation in oceans) with the model of ionospheric irregularities developed by the Defense Nuclear Agency. Expressions are given for calculating signal decorrelation in time, space and frequency. GRA

N86-30910# Pennsylvania State Univ., State College. Applied Research Lab.
PHASE COMPARISON TIME DELAY ESTIMATION USING WIDEBAND SIGNALS M.S. Thesis
J. D. Hatlestad and D. W. Ricker Apr. 1986 77 p
(AD-A167025; TR-86-03) Avail: NTIS HC A05/MF A01 CSCL 17/2

A method of phase comparison time delay estimation using large time-bandwidth product signals is presented. This method compares the phases of the matched filters for each channel, and it is shown that for signals with symmetric power spectra, a meaningful estimate of the time delay can be expected from this phase information and knowledge of the carrier frequency of the signal. The estimator is evaluated while operating in white Gaussian noise which is in general correlated between channels, and curves are given for the density function, mean, and variance of the estimator for various noise assumptions. The estimator is shown to take advantage of the processing gain of large time-bandwidth product signals to reduce the variance of the time delay estimate. GRA

N86-30911# Naval Postgraduate School, Monterey, Calif.
CERENKOV RADIATION AND ELECTROMAGNETIC PULSE PRODUCED BY ELECTRON BEAMS TRAVERSING A FINITE PATH IN AIR
F. R. Buskirk and J. R. Neighbours Mar. 1986 29 p
(AD-A167058; NPS 61-86-011) Avail: NTIS HC A03/MF A01 CSCL 20/8

Coherent Cerenkov radiation has been investigated previously in the time domain for an infinite path. The present calculations for a finite path length show an effect analogous to diffraction (in the frequency domain) in which radiation fields appear both at Cerenkov angles and at other angles. The latter have previously been named electromagnetic pulse fields. GRA

N86-30912# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
TWO-DIMENSIONAL SIGNAL PROCESSING AND STORAGE AND THEORY AND APPLICATIONS OF ELECTROMAGNETIC MEASUREMENTS Annual Report, 1 Jan. - 31 Dec. 1985
R. W. Schafer and D. T. Paris 1 Jan. 1986 30 p
(Contract DAAG29-84-K-0024)
(AD-A167175) Avail: NTIS HC A03/MF A01 CSCL 09/2

This is an annual report on research conducted under the auspices of the Joint Services Electronics Program. Specific topics covered are: digital signal processing, parallel processing architectures, two-dimensional optical storage and processing, hybrid optical/digital signal processing, electromagnetic measurements in the time domain, and automatic radiation measurements for near-field and far-field transformations. GRA

N86-30913# Naval Research Lab., Washington, D. C.
AN INVESTIGATION OF DIELECTRIC LOADED RIDGED WAVEGUIDE Final Report, Jun. 1981 - Dec. 1984
Charles W. Young, Jr. 31 Mar. 1986 145 p
(AD-A167269; NRL-8917) Avail: NTIS HC A07/MF A01 CSCL 09/1

In this report, a complete modal analysis is made for ridged waveguide partially loaded with dielectric. Cutoff frequency calculations are derived for the different waveguide modes to provide the actual single mode bandwidth. Mathematical solutions for propagation characteristics, both phase and loss, and for peak power breakdown levels are derived for the dominant mode. It is shown that true TE or TM modes do not exist in the dielectric loaded ridged waveguide, contrary to the assumption made in the only published analysis of such waveguide. Numerical examples are cited to demonstrate the large single mode bandwidths that may be achieved with dielectric loaded ridge waveguide and the considerable increase in theoretical peak power breakdown levels over that of either empty ridged waveguide or dielectric slab loaded rectangular waveguide having the same single mode bandwidth. Author (GRA)

N86-30914# Ballistic Research Labs., Aberdeen Proving Ground, Md.
A TWO-DIMENSIONAL STUDY OF THE INFLUENCE ON TARGET LOADING OF NUMERICAL WAVE REFLECTIONS FROM TRANSMISSIVE COMPUTATIONAL BOUNDARIES Final Report, Feb. 1984 - Jun. 1985
Richard E. Lottero and John D. Wortman Mar. 1986 48 p
(AD-A167299; BRL-MR-3503) Avail: NTIS HC A03/MF A01 CSCL 20/4

This report quantifies the changes in the loading on a target caused by the arrival of artificial, numerically-induced reflections of waves from the transmissive boundaries of a computational grid. Several computations were performed, using the two-dimensional Cartesian coordinates mode of the Ballistic Research Laboratory's version of the airblast HULL hydrodynamics computer code. HULL uses a two-step, explicit differencing method to solve the inviscid, unsteady Euler equations. A target is simulated in the computational grid by generating aggregates of rigid, immobile, and impermeable flow-field cells. The simple transmissive boundaries in HULL simulate a zero-gradient condition across the boundary for both the pressure and the normal component of velocity. Simple transmissive boundaries such as these will partially reflect waves that strike them, including shock, compression, and expansion waves. The strength of these reflected waves is directly related to the strength of the incident waves. These reflected waves then travel back into the computational grid, modifying the flow-field conditions in the regions through which they pass, thereby ending the simulation of free-field conditions. GRA

N86-30915# Pittsburgh Univ., Pa. Center for Multivariate Analysis.
SIGNAL PROCESSING USING MODEL SELECTION METHODS
Z. D. Bai, P. R. Krishnaiah, and L. C. Zhao Jan. 1986 20 p
(Contracts N00014-85-K-0292; F49620-85-C-0008)
(AD-A167318; TR-86-03; AFOSR-86-0253TR) Avail: NTIS HC A02/MF A01 CSCL 09/4

In this paper, the authors gave a review of some recent developments on multivariate statistical techniques for detection of the number of signals using eigenvalues. The main emphasis of the review is on efficient detection criterion (EDC) procedures proposed by the authors recently. These procedures are strongly consistent. GRA

N86-30916# Naval Underwater Systems Center, New London, Conn.
CONNECTICUT ELF (EXTREMELY LOW FREQUENCY) FIELD-STRENGTH MEASUREMENTS, AUGUST TO DECEMBER 1977 AND JULY TO SEPTEMBER 1978
Peter R. Bannister 5 Mar. 1986 100 p
(AD-A167344; NUSC-TR-7357) Avail: NTIS HC A05/MF A01 CSCL 20/14

From August 1976 to September 1978, extremely low frequency (ELF) field-strength measurements were taken continuously in Connecticut. The results of measurements taken from August to December 1977 and from July to September 1978 are discussed in this report. The principal result is that, for the 2 year period of August 1976 to September 1978, amplitude peak-to-trough variations of 5 dB, or greater, were observed 25 percent of the time. GRA

N86-30917# Department of the Air Force, Washington, D.C.
MOTION SENSITIVE FRAME INTEGRATION Patent Application
Roger A. May, inventor (to Air Force) Filed 24 Feb. 1986 15 p
(AD-D012291; US-Patent-Appl-SN-831894) Avail: NTIS HC A02/MF A01 CSCL 17/2

Noise smoothing of imaging data is performed using frame integration, by averaging pixels over time instead of space, without resulting in a smear of moving objects by: sensing image motion; and enabling frame integration on only stationary scene pixels. Image motion is sensed by: producing a differencing signal which indicates the difference between new image data and frame integrated data; and comparing the differencing signal with a threshold signal. When the threshold signal has a value which approximately equals expected image noise, then the image data processed by a particular pixel may be deemed non-moving when the difference signal is less than the threshold signal, and the image data may be deemed to depict moving objects otherwise. Finally, image data is conducted unprocessed to the display for moving scene pixels, while frame integrated image data is conducted to the display for stationary scene pixels. Author (GRA)

N86-30918# Department of the Air Force, Washington, D.C.
DOUBLE SIDEBAND GENERATION WITH SERRODYNE MODULATORS Patent Application
Minarik, inventor (to Air Force) et al Filed 3 Feb. 1986 19 p
(AD-D012293; US-Patent-Appl-SN-825107) Avail: NTIS HC A02/MF A01 CSCL 17/2

The present invention utilizes a pair of single sideband serrodyne frequency modulators to achieve double sideband generation with carrier and unwanted sideband suppression that is characteristic of the individual single sideband serrodyne modulator. The RF input signal is applied to a 90 degree 3 dB hybrid power divider to obtain two RF carrier signals that are

90 degrees out of phase. One of the RF carrier signals is applied to the first single sideband serrodyne modulators which is used to frequency shift the drive signal above the RF carrier signal. The other serrodyne modulator is used to frequency shift the drive signal below the RF carrier signal. The output signals from the individual modulators which are 90 degrees out of phase, are then combined in a second 90 degree 3 dB hybrid power divider to obtain the upper and lower sidebands at the output. In order to achieve true double sideband, suppressed-carrier operation, the modulating frequencies to each serrodyne modulator would be the same, but out of phase. GRA

N86-30919# Oak Ridge National Lab., Tenn.
A 3-D ANALYSIS OF MAXWELL'S EQUATIONS FOR CAVITIES OF ARBITRARY SHAPE
J. H. Whealton, G. L. Chen, R. W. McGaffey, R. J. Raridon, E. F. Jaeger, M. A. Bell, and D. J. Hoffman Mar. 1986 26 p
(Contract DE-AC05-84OR-21400)
(DE86-007883; ORNL/TM-9792) Avail: NTIS HC A03/MF A01

A three-dimensional analysis of cavity antennas is presented. The analysis is based on the finite difference method with a successive overrelaxation convergence scheme. This method permits the calculation of resonance frequencies and corresponding electric and magnetic fields of eigenmodes in a cavity antenna with an arbitrary shape. DOE

N86-30920# Sandia National Labs., Albuquerque, N. Mex.
METHODS FOR DEVELOPING JAM-RESISTANT SECURITY COMMUNICATIONS NETWORKS AT FIXED-SITE FACILITIES
D. J. Gangel, J. E. Heustess, and M. K. Snell 1986 6 p Presented at the Carnahan Conference on Security, Lexington, Ky., 14 May 1986
(Contract DE-AC04-76DP-00789)
(DE86-001321; SAND-85-2128C; CONF-860519-1) Avail: NTIS HC A02/MF A01

Considerable work has been done identifying and developing equipment and procedures that can be used to improve the survivability of a security communications network during a jamming assault. Insight is given into alternate communications methods that can be used to develop resistance to jamming by supplementing existing radio communications. The spatial properties of jamming are then discussed and examples of how these properties can be exploited are examined. Also discussed are spread-spectrum radios that are highly resistant to jamming and the importance of jamming exercises. DOE

N86-30921# Begeleidingscommissie Remote Sensing, Delft (Netherlands).
THE DETERMINATION OF MODULATION TRANSFER FUNCTIONS FROM THE 'NOORDWIJK' RADAR MEASUREMENTS IN 1978 AND 1979
P. Hoogeboom 19 Aug. 1985 81 p
(BCRS-85-02; FEL-TNO-1985-70; ESA-86-97494) Avail: NTIS HC A05/MF A01

Times series of 20 min and longer, simultaneously recorded from a wave gage and an X-band FM-CW radar are analyzed. Modulation Transfer Functions (MTF) are determined as a function of polarization and incidence angle. The coherence between the wave gage signal and the radar signal is taken into account (cross spectral analysis). For comparison with previous results, the incoherent MTF is also determined (division of auto power spectra). A theoretical background for the MTF and its coherent determination is given. The measurement configuration and the preprocessing of the data are discussed. ESA

N86-30922# Technische Hogeschool, Eindhoven (Netherlands). Vakgroep Telecommunicatie EC.
RECEIVER FOR DIGITAL RADIO BROADCASTING VIA SATELLITE [EEN ONTVANGER VOOR DIGITALE RADIO-OMROEP VIA EEN SATELLIET]
C. R. deGraaf Oct. 1984 106 p In DUTCH
(ESA-86-97313) Avail: NTIS HC A06/MF A01

Quadrature Phase Shift Keying (QPSK) demodulators were investigated; a differential-coherent demodulator (with delay-line) for a 20.48 Mbit/sec and 118 MHz medium frequency was developed. A modified professional coherent demodulator (With Costas-loop carrier wave regaining) (CD), was compared with the DQPSK. At the cost of higher circuit complexity and more adjustings, the CD shows better performances; both demodulators show deviation values < 2dB. Applied bit error detection and correction methods were investigated and decoding tables were developed. In cases of high system reserves (e.g., central antenna installations of TV-receiver installations) the cheaper DQPSK is recommended. A prefabricated delay-line (and medium frequency filter) in surface acoustic wave technique is recommended to avoid complicated adjusting procedures. ESA

N86-30923# Technische Hogeschool, Eindhoven (Netherlands). Vakgroep Telecommunicatie.
DEVELOPMENT OF A SMALL MULTIFUNCTIONAL GROUND STATION (MGS) FOR SATELLITE COMMUNICATION ON 11/14 GHz [DE ONTWIKKELING VAN EEN KLEIN MULTIFUNKTIONEEL GRONDSTATION VOOR SATELLIETCOMMUNCATIE OP 11/14 GHZ]
W. H. G. Deguelle Mar. 1984 133 p In DUTCH
(ESA-86-97314) Avail: NTIS HC A07/MF A01

Experiments on digital telephony (using separate carrier waves for each channel) and image telephony with 32 kbit/sec and 8.448 Mbit/sec transmission rates, were done using an MGS with a 3 m antenna. System aspects of digital satellite communication and requirements and development of a ground station were treated. An orthomode transducer, used for simultanous transmission and reception with one antenna, is discussed. Noise ratio, phase noise characteristics, and technical realization of the receiver chain are treated. Realization of the transmitter chain and the impact of nonlinear effects of traveling wave tubes on the system degradation are discussed. Experiments on analog TV-reception from the OTS were carried out. ESA

N86-30924# Technische Hogeschool, Eindhoven (Netherlands). Vakgroep Telecommunicatie EC.
THE CLASSICAL RADIOMETER EQUATION IN A LIMITED MEDIUM IN WHICH DISCRETE PARTICLES ABSORB AND SCATTER [DE KLASSIEKE RADIOMETER VERGELIJKING IN EEN BEGRENSD MEDIUM, WAARIN DISKRETE DEELTJES ABSORBEREN EN VERSTROOIEN]
G. Kuiken Jun. 1984 174 p In DUTCH
(ESA-86-97315) Avail: NTIS HC A08/MF A01

Conversion temperature (CT) calculations of absorbing and scattering particles in a precipitation medium were performed using the radiation equation and a cylindrical precipitation model. Data of the cumulative distribution function of satellite transmission path attenuation are necessary for satellite/ground-station connection designs. Rain, wind direction, and wind velocity impact on CT was investigated. Calculated and measured CT values were compared at 11.4 GHz frequency. The CT values calculated with a Joss-Thunderstorm drop distribution and a 0.5 ground emission coefficient are located in the 250 to 260 K area. The calculations agree with a cumulative distribution determined on a 66 hr registration time. ESA

N86-30925# Technische Hogeschool, Eindhoven (Netherlands). Vakgroep Telecommunicatie EC.
PROPAGATION RESEARCH OF A SATELLITE COMMUNICATION PATH AT THE TECHNICAL UNIVERSITY, EINDHOVEN (THE NETHERLANDS) USING OTS: MODELING AND MEASUREMENTS [PROPAGATIEONDERZOEK OP EEN SATELLIETCOMMUNICATIEPAD MET BEHULP VAN DE OTS AAN DE THE: MODELVORMING EN METINGEN]
A. C. M Stokkermans Dec. 1984 176 p In DUTCH
(ESA-86-97316) Avail: NTIS HC A09/MF A01

The modeling of electromagnetic wave damping and depolarization by rain was investigated to create a base for satellite communication systems design. Models for Intelsat concerning adaptive compensation for depolarization are discussed. Propagation measurements results with OTS are described. Processing

programs were developed. Using these results, statements concerning the absorber temperature to be used when predicting the damping with a radiometer are given. Data processing recommendations for future experiments are presented. ESA

N86-30926# Technische Hogeschool, Eindhoven (Netherlands). Vakgroep Elektromechanica en Vermogenselektronica.
APPLICATION OF AN ADDITIONAL CONTROLLABLE LOAD (ACL) WITH CHOPPER CONNECTED TO THE DIRECT CURRENT LINK (DCL) OF AN AUTONOMOUS WIND ENERGY POWER SYSTEM (WEPS) [TOEPASSING VAN EEN EXTRA REGELBARE BELASTING MET CHOPPER DIE WORDT AANGESLOTEN OP DE GELIJKSTROOMTUSSENTRAP VAN EEN AUTONOME WINDENERGIECENTRALE]
A. H. A. M. Smets May 1984 125 p In DUTCH
(EMV84-05; ESA-86-97318) Avail: NTIS HC A06/MF A01

An ACL consisting of a (fast) thyristor chopper with indirect commutation and loaded by a resistor is described. The ACL provides a reduction of grid voltage distortions, reactive power of the WEPS diesel generator, and the amplitude of higher harmonic currents in the autonomous grid. Ripple currents in the DCL are limited by the connection between chopper and DCL. An additional choke is connected in series with the existing choke in the DCL. Chopper and a smoothing capacitor were connected with one pole to the junction of both chokes. A resonance circuit is formed using chokes and capacitor. The resonance frequency is chosen such that no impermissible oscillations occur in the DCL. Equations to calculate components of the DCL and chopper for their dimensioning were derived. In an experimental set-up consisting of a part of the WEPS, measurements were carried out. ESA

N86-30927# Technische Hogeschool, Eindhoven (Netherlands). Vakgroep Telecommunicatie EC.
FOUR-PHASE MODEMS FOR A SATELLITE CHANNEL: DEMODULATION VIA DIFFERENTIAL DETECTION [VIER FASE-MODEMS VOOR EN SATELLITE-KANAAL: DEMODULATIE VIA DIFFERENTIELE DETEKTIE]
J. L. Manders May 1984 60 p In DUTCH; ENGLISH summary
(ESA-86-97390) Avail: NTIS HC A04/MF A01

Two quarternary phase shift keying modems in which demodulation takes place according to the principle of differential detection (DQPSK-modems) were developed, for investigations concerning digital transmission via communication satellites. Both modems, one with a 4 Mbit/sec bit rate and Nyquist Shaping (NS) in the transmitter, the other a 8.448 Mbit/sec bit rate and NS in the receiver, work on a 70 MHz intermediate frequency. Bit error rate was measured in back-to-back operation, via a translator loop, and via the A2 transponder of the OTS-2 satellite. The 4 Mbit/sec modem shows a 2.5 dB degradation with respect to the ideal DQPRS curve, while the 8.448 Mbit/sec modem shows a 1.8 dB deviation at a Pe=0.0001 random error. ESA

N86-30928# Technische Hogeschool, Delft (Netherlands). Vakgroep Microgolftechniek.
A MODEL DESCRIPTION FOR RADAR REFLECTION ON THE SEA SURFACE 2 [EEN MODELBESCHRIJVING VOOR DE RADARREFLECTIE AAN HET ZEE-OPPERVLAK 2]
L. Krul May 1984 19 p In DUTCH
(ESA-86-97553) Avail: NTIS HC A02/MF A01

The dispersion of electromagnetic waves at the rough sea surface was studied. The radar signature of a surface covered with a two-dimensional collection of point objects was treated. Speckle and resolution characteristics of the voltage in flight direction were investigated. ESA

N86-30929# National Telecommunications and Information Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
SPACE-TIME PROCESSING FOR WEAK SIGNAL DETECTION IN NON-GAUSSIAN AND NONUNIFORM ELECTROMAGNETIC INTERFERENCE (EMI) FIELDS
David Middleton Feb. 1986 185 p Sponsored by DOD
(PB86-193406; NTIA-CR-86-36) Avail: NTIS HC A09/MF A01
CSCL 09D

A canonical theory of threshold, or weak-signal detection in

A canonical theory of threshold, or weak-signal detection in non-Gaussian space-time fields is developed (Part 1) and Implede-sired signals and non-Gaussian electromagnetic interference (EMI) environments. Both optimum threshold and suboptimum processing algorithms are obtained and their performance evaluated in the general weak-signal regimes. The major extension of the present study with regard to recent work involving weak-signal reception is to include the effects of nonuniform spatial noise fields on beam forming and signal detection with arbitrary arrays. Various array structures, fading models, noise statistics (Class A, B noise, etc.), as well as numerical examples are included, to illustrate the concepts, methods, and applications for telecommunication environments. GRA

N86-30930*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
WILD BEARING ANALYSIS. EAAF (EXTENDED ALGORITHM ANALYSIS FAMILY) Interim Report
Michael Rennie 10 Jul. 1985 14 p Prepared in cooperation with Mathematical Analysis Research Corp., Claremont, Calif.
(Contract NAS7-918)
(NASA-CR-176985; JPL-D-2783; NAS 1.26:176985; AD-A166509; AD-E750871; TM-3) Avail: NTIS HC A02/MF A01 CSCL 17C

This is one of a series of algorithm analysis reports performed for the US Army Intelligence Center and School covering selected algorithms in existing or planned Intelligence and Electronic Warfare (IEW) systems. This report addresses derivation of a method of accounting probabilistically for the possibility of a given bearing being wild. It is an interim report on one of several methodological investigations in progress in this area. Author (GRA)

N86-30931# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
DETERMINATION OF ANTENNAE PATTERNS AND RADAR REFLECTION CHARACTERISTICS OF AIRCRAFT
H. Bothe, D. Macdonald, and A. Pool, ed. May 1986 138 p
(AGARD-AG-300-Vol-4; ISBN92-835-1530-7) Avail: NTIS HC A07/MF A01

The different types of aircraft antennas, their radiation characteristics and their preferred siting on the airframe are described. Emphasis is placed on the various methods for determining aircraft antenna radiation patterns (ARP) and advantages, disadvantages and limitations of each method are indicated. Mathematical modelling, model measurements and in-flight measurements in conjunction with the applied flight test techniques are included. Examples of practical results are given. Methods of determining aircraft radar characteristics are also described, indicating advantages, disadvantages and limitations of each method. Relevant fundamentals of radar theory are included only as necessary to appreciation of the real meaning of radar cross section (RCS) and angular glint. The measuring methods included are dynamic full-scale, static full-scale, sub-scale optical, ultrasonic and radio modelling. References are made to RCS measuring facilities in the USA and Europe and the UK Radio Modelling Facility is used extensively to exemplify the sub scale technique. Author

N86-30797# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
DEVELOPMENT OF AN ANTENNA STRUCTURE FOR A DEPLOYABLE OFFSET ANTENNA
H. Herbig, W. Tauber, and H. Vorbrugg *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 329-336 (For primary document see N86-30758 22-18)
(Contract ESTEC-5206/82-NL-PB(S6))
Avail: NTIS HC A16/MF A01

N86-30798# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
STRUCTURAL ANALYSIS, MANUFACTURING AND TEST EVALUATION OF A POLARIZATION SENSITIVE REFLECTOR
W. Weiss, K. Pfeifer, and R. Leitner *In* ESA Proceedings of a

Workshop on Composites Design for Space Applications Feb. 1986 p 337-347 (For primary document see N86-30758 22-18) (Contract ESTEC-5494/84-NL(CM))
Avail: NTIS HC A16/MF A01

N86-31086# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
PRINCIPLE OF SAR AND X-SAR PERFORMANCE. THE X-SAR/SIR-C MISSION. SOME REMARKS CONCERNING ORGANIZATION ASPECTS
H. Oettl *In its* The X-SAR Science Plan Nov. 1985 p 11-26 (For primary document see N86-31084 22-42)
Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

N86-31087# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
RADAR TECHNOLOGY
F. Heel and D. Solimini *In its* The X-SAR Science Plan Nov. 1985 p 27-41 (For primary document see N86-31084 22-42)
Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

N86-31413*# Houston Univ., Tex. Dept. of Applied Mathematical Sciences.
DISTRIBUTED SYNTHETIC APERTURE RADAR SIMULATION
Brian A. Bourgeois *In* NASA. Johnson Space Center NASA/American Society for Engineering Educaqtion (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 8 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 17I

N86-31085# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
THE X-SAR SCIENCE TEAM
H. Oettl *In its* The X-SAR Science Plan Nov. 1985 p 7-10 (For primary document see N86-31084 22-42)
Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N86-30932*# Georgia Inst. of Tech., Atlanta. Microelectronics Research Center.
THEORETICAL AND MATERIAL STUDIES ON THIN-FILM ELECTROLUMINESCENT DEVICES Biannual Report, 1 Oct. 1985 - 31 Mar. 1986
C. J. Summers and K. F. Brennan Jul. 1986 37 p
(Grant NAG1-586; Proj. A-4168)
(NASA-CR-177150; NAS 1.26:177150; BAR-2) Avail: NTIS HC A03/MF A01 CSCL 09A

A theoretical study of resonant tunneling in multilayered heterostructures is presented based on an exact solution of the Schroedinger equation under the application of a constant electric field. By use of the transfer matrix approach, the transmissivity of the structure is determined as a function of the incident electron energy. The approach presented is easily extended to many layer structures where it is more accurate than other existing transfer matrix or WKB models. The transmission resonances are compared to the bound state energies calculated for a finite square well under bias using either an asymmetric square well model or the exact solution of an infinite square well under the application of an electric field. The results show good agreement with other existing models as well as with the bound state energies. The calculations were then applied to a new superiattice structure, the variably spaced superlattice energy filter, (VSSEP) which is designed such that under bias the spatial quantization levels fully align. Based on these calculations, a new class of resonant tunneling superlattice devices can be designed. Author

N86-30933*# Foldes, Inc., Wayne, Pa.
A DESIGN STUDY FOR THE USE OF A MULTIPLE APERTURE DEPLOYABLE ANTENNA FOR SOIL MOISTURE REMOTE SENSING SATELLITE APPLICATIONS Final Report
Peter Foldes Aug. 1986 208 p
(Contract NAS1-17209)
(NASA-CR-178154; NAS 1.26:178154) Avail: NTIS HC A10/MF A01 CSCL 09A

The instrumentation problems associated with the measurement of soil moisture with a meaningful spatial and temperature resolution at a global scale are addressed. For this goal only medium term available affordable technology will be considered. The study while limited in scope, will utilize a large scale antenna structure, which is being developed presently as an experimental model. The interface constraints presented by a singel Space Transportation System (STS) flight will be assumed. Methodology consists of the following steps: review of science requirements; analyze effects of these requirements; present basic system engineering considerations and trade-offs related to orbit parameters, number of spacecraft and their lifetime, observation angles, beamwidth, crossover and swath, coverage percentage, beam quality and resolution, instrument quantities, and integration time; bracket the key system characteristics and develop an electromagnetic design of the antenna-passive radiometer system. Several aperture division combinations and feed array concepts are investigated to achieve maximum feasible performance within the state STS constraints. B.G.

N86-30934# Naval Research Lab., Washington, D. C.
ONE DIMENSIONAL MODELS FOR RELATIVISTIC ELECTRON BEAM DIODE DESIGN Interim Report, 1 Jan. 1984 - 30 Apr. 1985
John M. Finn, Arne W. Fliflet, and Wallace M. Manheimer 28 Feb. 1986 28 p
(AD-A165953; NRL-MR-5727) Avail: NTIS HC A03/MF A01 CSCL 09/1

Several one dimensional models are derived which approximate the relativistic flow of high current beams in diodes. Using these models as a starting point, a diode for a 1 GW beam for a 35 GHz gyrotron oscillator is easily designed. The analysis is based on four one dimensional planar or conical models for electron flow in diodes. The planar models are relativistic and can be used to obtain electrode shapes for space charge limited flow. The conical models shed light on important geometric effects. Principally, it is shown that the space charge limited current is larger in realistic geometries than in the corresponding planar configuration. GRA

N86-30935# Naval Ocean Systems Center, San Diego, Calif.
TESTABILITY MEASURES ON A STATE-OF-THE-ART CIRCUIT Final Report
J. C. Bussert Feb. 1986 61 p
(AD-A165978; NOSC/TD-835) Avail: NTIS HC A04/MF A01 CSCL 09/5

By means of design for testability (DFT) techniques, the NOSC Test Technology Office (Code 936) evaluated testability improvements in a state-of-the-art printed-circuit board. Data were gathered to provide a direct comparison among various testability figure of merit (TFOM) tools. GRA

N86-30936# Polytechnic Inst. of New York, Brooklyn. Microwave Research Inst.
BASIC RESEARCH IN ELECTRONICS (JSEP) Annual Report, 1 Jan. - 31 Dec. 1985
Arthur A. Oliner 31 Dec. 1985 88 p
(Contract F49620-85-C-0078)
(AD-A166075; POLY-MRI-1446-85; AFOSR-86-0078TR) Avail: NTIS HC A05/MF A01 CSCL 09/5

This report presents a summary of the scientific progress and accomplishments on research projects funded by the Joint Services

Electronics Program (JSEP) for the contract periods from 1 January 1985 through 31 December 1985. It does not contain information regarding accomplishments on research projects funded in other ways. The Joint Services Electronics Program at the Polytechnic is the core of interdisciplinary research in electronics encompassing programs in the Departments of Electrical Engineering, Physics and Chemistry under the aegis of the Microwave Research Institute. The research encompassed by this program is grouped under three broad categories: Electromagnetics, Solid State Electronics and Information Electronics. The detailed projects (research units) comprising the complete program are listed in the Table of Contents. GRA

N86-30937# Brown Univ., Providence, R. I. Center for Dynamical Systems.
STOCHASTIC SYSTEMS WITH SMALL NOISE, ANALYSIS AND SIMULATION: A PHASE LOCKED LOOP EXAMPLE
P. Dupuis and H. Kushner Aug. 1985 49 p
(Grant AF-AFOSR-0116-81)
(AD-A166148; LCDS-85-20; AFOSR-86-0033TR) Avail: NTIS HC A03/MF A01 CSCL 09/4

Systems with wide bandwidth noise inputs are a common occurrence in stochastic control and communication theory and elsewhere; e.g., tracking or synchronization systems such as phase locked loops (PLL). One is often interested in calculating such quantities as the probability of escape from a desired error set, in some time interval, or the mean time for such escape. Diffusion approximations (the system obtained in the limit bandwidth approaches infinity) are often used for this, being easier to analyze. We study a particular form of the PLL owing to the great practical importance of the system and because it provides a useful vehicle for understanding the extent of validity of the asymptotic methods for such systems. The basic analytical techniques are from the theory of large deviations. One seeks information on the escape probabilities, mean times, and on the most likely exit paths and exit locations. Also, we seek information on the interactions between the signals to be tracked and the noise which are most likely to lead to exit. The large deviations technique is eminently suited to this job. Simulations are taken in order to understand the range of validity of the asymptotic method. Agreement between the predictions and sample estimates is good over noise intensity levels which seem to be ever larger than those typically occurring in practice. GRA

N86-30938# Missouri Univ., St. Louis.
FUNDAMENTAL QUANTUM 1/f NOISE IN ULTRASMALL SEMICONDUCTOR DEVICES AND THEIR OPTIMAL DESIGN PRINCIPLES Progress Report, 1 May - 30 Nov. 1985
Peter H. Handel 1 Dec. 1985 35 p
(Grant AF-AFOSR-0130-85)
(AD-A166154; AFOSR-85-0130TR; PR-1) Avail: NTIS HC A03/MF A01 CSCL 09/3

As a first step of a more general study of 1/f noise in semiconductor devices n(+)(-)p diodes have been investigated with emphasis on HgCdTe photodetectors. Quantum 1/f noise has been calculated in the surface and bulk recombination currents, in the diffusion and field currents, and in the tunneling currents. Due to the large localized electric field at the surface, a larger fractional quantum 1/f noise power is obtained for surface recombination currents than for similar bulk recombination currents. All quantum 1/f noise calculations are first principles calculations with no free parameters, based on the quantum 1/f effect in scattering and recombination cross sections, as well as in tunneling rates. Together, the quantum 1/f mobility fluctuations, bulk and surface recombination speed fluctuations and tunneling rate fluctuations can account for the observed 1/f noise and can be used for optimizing small devices, as indicated by experiments at SBRC, Univ. of Minnesota and Florida. Some suggestions are given at the end of Sec. II. For devices larger than 10 microns coherent state quantum 1/f noise becomes important, according to a new interpolation formula. The new interpolation formula which bridges the gap between conventional (incoherent) quantum 1/f noise and coherent state quantum 1/f noise is in general agreement with measurements in p-n diodes and transistors, and will be tested in more detail in the near future. The theory has also been successfully applied to SQUIDs. GRA

N86-30939# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
STUDY OF ELECTRICAL RESISTIVITY ON THE LOCATION AND IDENTIFICATION OF CONTAMINATION Ph.D. Thesis
Brian D. McCarty 1985 273 p
(AD-A166405; AD-E950826; AFIT/CI/NR-86-14T) Avail: NTIS HC A12/MF A01 CSCL 09/3

Electrical resistance studies were conducted in two laboratory models to determine electrical resistivity relationships and to use those defined relationships to identify contamination spikes. A good correlation was established between resistance data and the composition of leachate and copper spiked leachate gelatin blocks under study. The major variable that could not be eliminated from this study which had the greatest effect on data was moisture content. This thesis contains a review of the theory and field application of electrical resistivity, a description of the experimental approach used, and a summary of the data collected. GRA

N86-30940# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Science.
SIGNAL DELAY IN LEAKY RC MESH MODELS FOR BIPOLAR INTERCONNECT
Peter OBrien and John L. Wyatt, Jr. Oct. 1985 68 p
(Contract N00014-80-C-0622; Grant NSF ECS-83-10941)
(AD-A166786; VSLI-MEMO-85-278) Avail: NTIS HC A04/MF A01 CSCL 09/5

This paper extends the results of Penfield and Rubinstein on signal delay in RC tree networks. Both estimates and bounds are derived for the step response of leaky RC trees and meshes, a class of networks that is appropriate for modelling interconnect in digital bipolar circuits. This paper is intended to serve as a tutorial as well as a research report. Therefore existing work is explained in some detail along with the derivation of new results.
Author (GRA)

N86-30941# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Science.
SYNTHESIS OF A SELF-TIMED CONTROLLER FOR A SUCCESSIVE-APPROXIMATION A/D CONVERTER
Tam-Anh Chu and Lance A. Glasser Oct. 1985 15 p
(Contract N00014-80-C-0622; Grant NSF MCS-79-15255)
(AD-A166788; VSLI-MEMO-85-274) Avail: NTIS HC A02/MF A01 CSCL 09/5

This paper documents the procedure for designing a self-timed controller for a successive-approximation A/D converter. From the functional specification, a Signal Transition Graph is constructed to describe the operation of the control circuit. This graph is then modified into a well-formed graph. Such a graph can be transformed into a deadlock-free and hazard-free implementation directly. The structure of the control circuit and the logic equations are then derived directly from the graph. Author (GRA)

N86-30942# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
SYNCHRONIZER FAILURE IN A/D CONVERTERS
Lance A. Glasser Oct. 1985 14 p
(Contract N00014-80-C-0622)
(AD-A166819; VLSI-MEMO-85-276) Avail: NTIS HC A02/MF A01 CSCL 09/5

Analog-to-digital converters that must produce a valid output in a specified period of time are subject to synchronizer failure. Three types of A/D converters are examined: flash converters, clocked successive approximation converters, and self-timed successive approximation converters. Lower bounds on their worst-case conversion time as a function of the fault probability are derived. GRA

N86-30943# Massachusetts Inst. of Tech., Cambridge. Dept.of Electrical Engineering and Computer Science.
A HIGH-SPEED ASYNCHRONOUS COMMUNICATION TECH-

NIQUE FOR MOS (METAL-OXIDE-SEMICONDUCTOR) VLSI SYSTEMS M.S. Thesis
Paul D. Bassett Dec. 1985 104 p
(Contract N00014-80-C-0622)
(AD-A166846; AD-E950814; VLSI-MEMO-85-283) Avail: NTIS HC A06/MF A01 CSCL 20/12

As MOS technologies advance, the relative differences between on-chip and off-chip delays increase. Drivers and receivers can be designed which allow high bit rate communications (greater than 100 Mbits/sec) between MOS chips at the expense of increased latency. Designing synchronous systems which couple a high clock frequency with large and variable delays is difficult and expensive due to the complexity of insuring that no delays violate the constraints imposed by synchronous operation. A circuit-based technique for automatically adjusting signal delays in an MOS system has been developed. The Dynamic Delay Adjustment (DDA) technique provides reliable high speed communications directly between MOS chips independent of the delay between the chips. The amount of phase jitter immunity provided by the synchronizer can be traded off against circuit complexity; the signal delays are adjusted continuously to track temperature induced delay variations. A 3 micron DDA synchronizer has been fabricated to confirm the validity of the DDA approach; test results will be presented. Author (GRA)

N86-30944# Massachusetts Inst. of Tech., Cambridge.
A COHERENT VLSI DESIGN ENVIRONMENT Semiannual Report, 1 Oct. - 31 Mar. 1986
Paul Penfield, Jr. 31 Mar. 1986 62 p
(Contract N00014-80-C-0622)
(AD-A166848; AD-E950814) Avail: NTIS HC A04/MF A01 CSCL 09/5

This report covers the period from October 1, 1985 through March 31, 1986. The research discussed here is described in more detail in several published and unpublished reports cited below. The CAD frame Schema has received limited but instructive applications. Connections to remote simulation servers are transparent to the user. More substantial uses are anticipated during the next half year. Waveform bounding results have been extended to ECL technology, and a variety of the results are being applied to an analog application in early vision. Many of the previous results have been transferred to industry and are being used in commercial simulators. Fundamental speed limits of collections of active devices with parasitics have been found. These are independent of how the devices are interconnected. A reliability simulator has been written, and models are being developed for it, to describe three important effects, namely mental migration, hot-electron trapping, and time-dependent dielectric breakdown. Work continues on the fat-tree architecture, and on the efficient realization of various classes of circuits. New results in graph bisection and routing were made during this period. It is now known how to imbed some classes of communications networks in others, for example binary trees in hypercubes. Author (GRA)

N86-30945# Avco-Everett Research Lab., Mass.
DIFFUSE DISCHARGE SWITCH ANALYSIS Final Report, 1 Jul. 1982 - 30 Sep. 1985
P. Rostler Feb. 1986 65 p
(Contract F33615-82-C-2249)
(AD-A167282) Avail: NTIS HC A04/MF A01 CSCL 09/1

The growth of streamers which leads to arcing is studied for the high current discharge needed to make an opening switch. The scaling of discharge parameters is analyzed for the switch application and previous experimental work on streamer growth is reviewed. A general theory of streamer growth is developed from fundamental gas and electrodynamic equations and an equation is derived which predicts the streamer growth rate and which can be evaluated numerically. The implications for e-beam controlled switches are discussed. GRA

N86-30946# Department of the Air Force, Washington, D.C.
GAS MIXTURE FOR TRIGGERABLE SPARK GAPS Patent Application
R. E. Wootton, inventor (to Air Force) Filed 12 Mar. 1986 17 p
(AD-D012289; US-Patent-Appl-SN-838976) Avail: NTIS HC A02/MF A01 CSCL 21/2

A particular gas mixture (90% N2 + 10% Xe) in a triggerable spark gap discharger is disclosed which allows the spark gap to be triggered with a low main-gap voltage over a much wider range of trigger voltages (e.g., 16-30 or more kV), than with nitrogen (e.g., 19-22 kV) or other commonly used gases and mixtures. The improvement is important where triggerable spark gaps are used in protective circuits. GRA

N86-30947# Department of the Navy, Washington, D. C.
CONTAINER FOR MULTICHIP HYBRID PACKAGE Patent Application
Ernest A. Capelle, inventor (to Navy) Filed 24 Jun. 1985 10 p
(AD-D012308; US-Patent-Appl-SN-747601) Avail: NTIS HC A02/MF A01 CSCL 09/5

A container for storing and handling multichip hybrid packages (MHP's) during manufacture, testing and inspection is described. The receptacle and cover are recessed to receive a wide range of MHP sizes and configurations. An aperture in the cover provides visible access to the MHP without removing it or opening the container. The container is made of electrically conductive, high temperature resistant carbon plastic for protection from electrostatic discharges and environmental temperature chamber testing. GRA

N86-30948# Sandia National Labs., Albuquerque, N. Mex.
MEASUREMENT OF INTERNAL CAPACITANCES OF INTEGRATED CIRCUITS
K. White, D. Palmer, C. F. Hawkins, and G. L. Martin 1986 9 p Presented at the Electronic Components Conference, Seattle, Wash., 5 May 1986 Prepared in cooperation with New Mexico Univ., Albuquerque
(Contract DE-AC04-76DP-00789)
(DE86-006494; SAND-85-2420C; CONF-860566-1) Avail: NTIS HC A02/MF A01

Direct probe measurements have been made of intra-transistor and interconnection capacitances in integrated circuit CMOS technologies down to 2 microns detail. Resolution of measurements have been confirmed to 1 femtofarad. These differential capacitance measurements are taken at 1 MHz, comparable to the normal frequency range of circuit operation. These measurements are performed directly on structures normally occurring on integrated circuit wafers, not on special enhanced capacitive test keys or using custon on-chip amplifiers. The method used the HP-4062B semiconductor parameter extractor. Elaborate shielding and ac-guarding of adjacent microfeatures were necessary to measure only the capacitances of interest. Extensive signal averaging and system capacitance canceling was performed. Although elaborate and detailed, the method developed can be used by any semiconductor production facility on their standard test structures. The voltage dependence of the junction capacitances of the drain to p-well and the gate to p-well were found consistent with calculation down to 2 micron dimensions. The gate to drain overlap capacitance was also examined allowing an estimate of the fringing contribution. DOE

N86-30949# Sandia National Labs., Albuquerque, N. Mex.
TESTING, DESIGN AND MODELING ISSUES IN RADIATION-HARDENED CMOS INTEGRATED CIRCUITS
James E. Gover and Mark R. Ackermann 1986 8 p Presented at the 3d International Workshop on Future Electron Devices, Tokyo, Japan, 11 Mar. 1986
(Contract DE-AC04-76DP-00789)
(DE86-007707; SAND-86-0334C; CONF-860385-1) Avail: NTIS HC A02/MF A01

Continued research and greater understanding of ionization damage mechanisms in silicon/silicon dioxide structures will lead to improved total dose modeling techniques and a better definition of proper total dose testing conditions. Combining computer models with laboratory test data will allow engineers to predict the total dose response of components for irradiation periods ranging from

years to less than a second. Recent progress in the understanding of dose-rate phenomena in integrated circuits has identified Rail Span Collapse as a possible upset mechanism. Use of this model aids the design of ICs expected to have an upset level above 1E10 rad(Si)/sec. Further research into photo current generation, rail span collapse, and local upset mechanisms will allow maximization of IC upset levels. DOE

N86-30950# Los Alamos National Lab., N. Mex.
EXPERIMENTAL MEASUREMENT OF ABLATION EFFECTS IN PLASMA ARMATURE RAILGUNS
Jerald V. Parker and William M. Parsons 1986 9 p Presented at the 3rd Symposium on Electromagnetic Launch Technology, Austin, Tex., 20-24 Apr. 1986
(Contract W-7405-eng-36)
(DE86-008740; LA-UR-86-943; CONF-8604147-3) Avail: NTIS HC A02/MF A01

Experimental evidence supporting the importance of ablation in plasma armature railguns is presented. Experiments conducted using the HYVAX and MIDI-2 railguns are described. Several indirect effects of ablation are identified from the experimental results. An improved ablation model of plasma armature dynamics is proposed which incorporates the restrike process. DOE

N86-30951# California Univ., Berkeley. Lawrence Berkeley Lab.
RELATIVISTIC KLYSTRON
R. Marks Sep. 1985 23 p
(Contract DE-AC03-76SF-00098)
(DE86-009217; LBL-20918) Avail: NTIS HC A02/MF A01

Theoretical analysis is presented of a relativisic klystron; i.e., a high-relativistic bunched electron beam which is sent through a succession of tuned cavities and has its energy replenished by periodic induction accelerator units. Parameters are given for a full-size device and for an experimental device using the FEL at the ETA; namely the ELF Facility. DOE

N86-30952# Sandia National Labs., Albuquerque, N. Mex.
NUMERICAL AND EXPERIMENTAL STUDY OF RESIDUAL STRESSES AND THERMAL FATIGUE IN SOLDERED ELECTRONIC ASSEMBLIES
R. J. Bourcier and J. J. Stephens 1986 28 p Presented at the Symposium on Computer Modeling of Fabrication Processes and Constitutive Behavior of Metals, Ottawa, Ontario, 15 May 1986
(Contract DE-AC04-76DP-00789)
(DE86-008779; SAND-86-0803C; CONF-860590-1) Avail: NTIS HC A03/MF A01

The assembly examined consists of thin plates of alumina, Kovar, 410 stainless steel and 6061 aluminum bonded together using layers of three different solder alloys: 63% Sn - 37% Pb, 50% Pb - 50% In and 40% In - 40% Sn - 20% Pb. Numerical simulation of the fabrication process was performed using a simplified axisymmetric finite element microcell model of the actual assembly. The alumina, Kovar, 410 stainless steel and 6061 aluminum layers were modeled as temperature-dependent elastic-plastic materials while the solder alloys were treated as creeping solids following solidification. Experimental testing of the solder alloys was used to generate input for the finite element code constitutive models. The numerical results of this study have provided guidelines for the successful fabrication of the subject assembly. In particular, slower cooling rates following solidification of the solders have been shown to dramatically lower bending stresses generated in the alumina plate. The experimental portion of the program has provided data on the degration of solder bond integrity used to thermal cycling and has identified possible important factors in the mechanical response of thin solder layers. DOE

N86-30953# Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.
CIRCULAR WAVEGUIDE MODE CONVERTERS AT 140 GHz
J. Trulsen, P. Woskoboinikow, and R. J. Temkin Jan. 1986 62 p
(Contract DE-AC02-78ET-51013)
(DE86-009075; DOE/ET-51013/173; PFC/RR-86-2) Avail: NTIS HC A04/MF A01

A unified derivation of the coupled mode equations for circular waveguide is presented. Also, approximate design criteria for TE/sub 0n/ to TE/sub 0n'/ axisymmetric, TE01 to TE11 wriggle, and TE01 to TM11 bend converters are reviewed. Numerically solving the coupled mode equations, an optimized set of mode converters has been designed for conversion of a 2 millimeter wave TE03 mode into TE11. This set consists of axisymmetric TE03 to TE02 and TE02 to TE01 converters followed by a wriggle TE01 to TE11 converter. This mode converter set was fabricated and tested using a 3 kW, 137 GHz gyrotron. A TE11 mode purity of better than 97% was achieved. The TE01 to TE11 wriggle converter was experimentally optimized for a measured conversion efficiency of better than 99% not including ohmic losses. DOE

N86-30954# Sandia National Labs., Albuquerque, N. Mex.
IN SITU EXAMINATION OF SEGREGATION AND WEAR PROCESSES OF PRECIOUS METAL ELECTRICAL CONTACT ALLOYS
L. E. Pope and D. E. Peebles 1986 28 p Presented at the 32nd Holm Conference, Boston, Mass., 27 Oct. 1986
(Contract DE-AC04-76DP-00789)
(DE86-009089; SAND-85-2570C; CONF-861051-2) Avail: NTIS HC A03/MF A01

The electrical contact resistance and friction coefficient of gold based (ASTM B541) and palladium based (ASTM B540) precious metal electrical contact materials have been measured simultaneously with an in situ pin-on-plate device in a scanning Auger analytical system. Intermittent surface analysis of the wear track was performed. The friction coefficient varied from 2.2 to 2.6 for high vacuum ambients containing oxygen (10(-6) torr) or nitrogen (10(-7) torr), but was 1.6 for an atmospheric ambient (700 torr) containing both oxygen (5%) and nitrogen (95%). In comparison, the friction coefficient was less than 0.5 in laboratory air. The electrical contact resistance was less than 15 milliohms for all test conditions but varied inversely with the friction coefficient. Segregation of sulfur to the wear track was observed in situ in the 700 torr ambient after as few as ten wear cycles. The friction coefficients for these tests were larger than for previous experiments; the increase was attributed to surface depletion of copper. DOE

N86-30955# Sandia National Labs., Albuquerque, N. Mex.
ESTIMATED BURST POWER REQUIREMENTS FOR SELECTED SDI MISSIONS
W. H. McCulloch 1986 22 p Presented at the 3rd Symposium on Space Nuclear Power Systems, Albuquerque, N. Mex., 13 Jan. 1986
(Contract DE-AC04-76DP-00789)
(DE86-005438; SAND-85-1840C; CONF-860102-6) Avail: NTIS HC A02/MF A01

Power requirements are estimated for several candidate missions proposed for the Strategic Defense Initiative. The missions of interest are those requiring large electric power supply and power conditioning systems for space-based directed energy weapons, including electromagnetic launchers, free-electron lasers, and neutral particle beams. In general, the power requirements are determined by working backward from lethality considerations, using preliminary descriptions of weapons performance and of candidate engagement scenarios. DOE

N86-30956# Lawrence Livermore National Lab., Calif.
SIMPLE, COMPACT, HIGH BRIGHTNESS SOURCE FOR X-RAY LITHOGRAPHY AND X-RAY RADIOGRAPHY
A. M. Hawryluk 19 Feb. 1986 10 p Presented at the Society of Photo-Optical Instrumentation Engineers Conference on Electron-beam, X-ray and Ion-beam Techniques for Submicrometer Lithographies, Santa Clara, Calif., 9 Mar. 1986
(Contract W-7405-eng-48)
(DE86-009723; UCRL-93474; CONF-8603111-1) Avail: NTIS HC A02/MF A01

A simple, compact, high brightness x-ray source has recently

been built. This source utilizes a commercially available, cylindrical geometry electron beam evaporator, which has been modified to enhance the thermal cooling to the anode. Cooling is accomplished by using standard, low-conductivity laboratory water, with an inlet pressure of less than 50 psi, and a flow rate of approx.0.3 gal/min. The anode is an inverted cone geometry for efficient cooling. The x-ray source has a measured sub-millimeter spot size (FWHM). The anode has been operated at 1 KW e-beam power (10 KV, 100 ma). Higher operating levels will be investigated. A variety of different x-ray lines can be obtained by the simple interchange of anodes of different materials. Typical anodes are made from easily machined metals, or materials which are vacuum deposited onto a copper anode. Typically, a few microns of material is sufficient to stop 10 KV electrons without significantly decreasing the thermal conductivity through the anode. The small size and high brightness of this source make it useful for step and repeat exposures over several square centimeter areas, especially in a research laboratory environment. For an aluminum anode, the estimated Al-K x-ray flux at 10 cms from the source is 70 microW/cm. DOE

N86-30957# United Kingdom Atomic Energy Authority, Harwell (England). Instrumentation and Applied Physics Div.
LOW LEVEL RADIATION TESTING OF MICROELECTRONIC COMPONENTS. PART 2: PRELIMINARY STUDIES OF GAMMA DOSE RATE EFFECTS ON CMOS INVERTERS, USING THE LORAD FACILITY Final Report
M. Hardman, J. Farren, D. Mapper, and J. H. Stephen Feb. 1985 78 p
(Contract ESTEC-5313/83-NL-HP)
(AERE-R-11679-Pt-2; HL85/1108-Pt-2; ESA-CR(P)-2174-Pt-2; ESA-86-97220) Avail: NTIS HC A05/MF A01

The Low Radiation Test Facility (LORAD) is described and results of threshold voltage shifts versus total ionizing dose on CMOS 4007 inverter devices are presented. The results indicate a dose rate effect and a dependence on the energy of the ionizing gamma photons. The tests demonstrate the validity of LORAD as a facility to simulate the space radiation environment. ESA

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N86-30958*# Stanford Univ., Calif. Dept. of Mechanical Engineering.
SIMULATION AND MODELING OF HOMOGENEOUS, COMPRESSED TURBULENCE
C.-T. Wu, J. H. Ferziger, and D. R. Chapman May 1985 206 p
(Contract NCC2-15)
(NASA-CR-176939; NAS 1.26:176939; SU-TF-21) Avail: NTIS HC A10/MF A01 CSCL 20D

Low Reynolds number homogeneous turbulence undergoing low Mach number isotropic and one-dimensional compression was simulated by numerically solving the Navier-Stokes equations. The numerical simulations were performed on a CYBER 205 computer using a 64 x 64 x 64 mesh. A spectral method was used for spatial differencing and the second-order Runge-Kutta method for time advancement. A variety of statistical information was extracted from the computed flow fields. These include three-dimensional energy and dissipation spectra, two-point velocity correlations, one-dimensional energy spectra, turbulent kinetic energy and its dissipation rate, integral length scales, Taylor microscales, and Kolmogorov length scale. Results from the simulated flow fields were used to test one-point closure, two-equation models. A new one-point-closure, three-equation turbulence model which accounts for the effect of compression is proposed. The new model accurately calculates four types of flows (isotropic decay, isotropic compression, one-dimensional compression, and axisymmetric expansion flows) for a wide range of strain rates. Author

N86-30959*# Computational Mechanics Consultants, Austin, Tex.
ADAPTIVE COMPUTATIONAL METHODS FOR SSME INTERNAL FLOW ANALYSIS Final Report
J. Tinsley Oden 1986 58 p
(Contract NAS8-36647)
(NASA-CR-178864; NAS 1.26:178864; TR86-05) Avail: NTIS HC A04/MF A01 CSCL 20D

Adaptive finite element methods for the analysis of classes of problems in compressible and incompressible flow of interest in SSME (space shuttle main engine) analysis and design are described. The general objective of the adaptive methods is to improve and to quantify the quality of numerical solutions to the governing partial differential equations of fluid dynamics in two-dimensional cases. There are several different families of adaptive schemes that can be used to improve the quality of solutions in complex flow simulations. Among these are: (1) r-methods (node-redistribution or moving mesh methods) in which a fixed number of nodal points is allowed to migrate to points in the mesh where high error is detected; (2) h-methods, in which the mesh size h is automatically refined to reduce local error; and (3) p-methods, in which the local degree p of the finite element approximation is increased to reduce local error. Two of the three basic techniques have been studied in this project: an r-method for steady Euler equations in two dimensions and a p-method for transient, laminar, viscous incompressible flow. Numerical results are presented. A brief introduction to residual methods of a-posterior error estimation is also given and some pertinent conclusions of the study are listed. M.G.

N86-30960*# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Mechanical Engineering.
MEASUREMENTS IN LIQUID FUEL SPRAYS Final Report, 15 Dec. 1983 - 14 Dec. 1985
Norman Chigier and Chien-Pei Mao 1985 51 p
(Contract NCC3-37)
(NASA-CR-177088; NAS 1.26:177088) Avail: NTIS HC A04/MF A01 CSCL 20D

A ground test facility is being established at NASA Lewis Research Center to simulate the environmental and flight conditions needed to study adverse weather effects. One of the most important components is the water spray system which consists of many nozzles fitted on spray bars. Water is injected through air-assisted atomizers to generate uniform size drops to simulate icing in clouds. The primary objective is to provide experimental data on drop size distribution over a wide range of operating conditions. Correlation equations for mean drop size and initial injection parameters are being determined to assist in the design and modification of the Altitude Wind Tunnel. Special emphasis is being placed on the study of the aerodynamic structure of the air-assisted atomizer sprays. Detailed measurements of the variation of drop size distribution and velocity as a function of time and space are being made. Accurate initial and boundary conditions are being provided for computer model evaluation. B.G.

N86-30961*# Lockheed Missiles and Space Co., Huntsville, Ala. Engineering Center.
VISCOUS FLOW COMPUTATIONS FOR ELLIPTICAL TWO-DUCT VERSION OF THE SSME HOT GAS MANIFOLD Interim Report
R. P. Roger 7 Mar. 1986 68 p
(Contract NAS8-36090)
(NASA-CR-178868; NAS 1.26:178868; LMSC-HEC-TR-D085161) Avail: NTIS HC A04/MF A01 CSCL 20D

The objective of the effort was to numerically simulate viscous subsonic flow in a proposed elliptical two-duct version of the fuel side Hot Gas Manifold (HGM) for the Space Shuttle Main Engine (SSME). The numerical results were to complement both water flow and air flow experiments in the two-duct geometry performed at NASA-MSFC and Rocketdyne. The three-dimensional character

of the HGM consists of two essentially different geometries. The first part of the construction is a concentric shell duct structure which channels the gases from a turbine exit into the second part comprised of two cylindrically shaped transfer ducts. The initial concentric shell portion can be further subdivided into a turnaround section and a bowl section. The turnaround duct (TAD) changes the direction of the mean flow by 180 degress from a smaller radius to a larger radius duct which discharges into the bowl. The cylindrical transfer ducts are attached to the bowl on one side thus providing a plane of symmetry midway between the two. Centerline flow distance from the TAD inlet to the transfer duct exit is approximately two feet. Details of the approach used to numerically simulate laminar or turbulent flow in the HGM geometry are presented. Computational results are presented and discussed. Author

N86-30962# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany). Abt. Mechanik.

PROBLEMS OF LARGE GAS FLOW MEASUREMENTS AT HIGH AND LOW PRESSURES [PROBLEME DER MESSUNG GROSSER GASSTROEME IM HOCH- UND NIEDERDRUCKBEREICH]

Ludwig Narjes, ed. Jul. 1985 458 p In GERMAN; ENGLISH summary Presented at Physik.-Tech. Bundesanstalt 45th Symp., Brunswick, 24-25 Jan. 1984

(PTB-Me-58; ISSN-0341-6720; ESA-86-96927) HC A20/MF A01

Precision measurement facilities of large gas flowrates and evaluation criteria are reviewed. Metrological principles, industrial measurement techniques, and normal measuring instruments were discussed. Laser Doppler anemometry applications to fluctuant gas flows; application of turbine wheel gas counters; vortex flowmeters; gas measuring bells; and the charging procedure for determination of stationary mass flowrates of gases are presented. For individual titles, see N86-30963 through N86-30982.

N86-30963# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).

METROLOGICAL EVALUATION CRITERIA FOR PRECISION MEASUREMENT OF LARGE GAS FLOWS [METROLOGISCHE BEWERTUNGSKRITERIEN ZUR PRAEZISIONSMESSUNG GROSSER GASSTROEME]

L. Narjes *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 7-15 In GERMAN (For primary document see N86-30962 22-34)

Avail: NTIS HC A20/MF A01

Metrological evaluation criteria, based on principles of flow physics, for a metrological connection system are presented, as well as calibrating curve and time-stability; classified measurement inaccuracy; number of connection phases for calibrating curve production; and connection procedure. Experience in using rotary reverse gas meters, turbine disk gas meters, and critical Venturi nozzles in precision measurement of large gas flows is reviewed. Calibrating curves are plotted to determine errors. Three high pressure gas meter test benches are compared. Test points are within the statistical inaccuracy. ESA

N86-30964# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).

FLOW RATE MEASURING DEVICES FOR GAS FLOWS [DURCHFLUSSMESSVERFAHREN FUER GASSTROEME] c35

K. W. Bonfig *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 16-42 In GERMAN (For primary document see N86-30962 22-34)

Avail NTIS HC A20/MF A01

Flowrate measuring devices are described: volume meter with fixed or mobile walls; turbine meter; throttling procedure; ultrasonic and Doppler methods; vortex method; rotary flowmeter; and swinging body flow measuring procedure. Flowrate can also be measured from the force exerted on bodies immersed in a fluid or based on thermodynamical principles. The characteristics and operating envelope of each device/method are given. ESA

N86-30965# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).

TWO COMPONENT VELOCITY MEASUREMENTS IN FLUCTUATING GAS FLOWS USING A LASER DOPPLER ANEMOMETER (LDA) [2-KOMPONENTEN-GESCHWINDIGKEITSMESSUNGEN IN FLUKTUIERENDEN GAS-STROEMUNGEN MIT HILFE EINES LASER-DOPPLER-ANEMOMETERS (LDA)]

K. A. Buetefisch, V. Strunck, F.-R. Grosche, J. Kompenhans, H.-R. Hoefer, and K.-H. Sauerland *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 43-51 In GERMAN (For primary document see N86-30962 22-34)

Avail NTIS HC A20/MF A01

A two component Laser Doppler Anemometer (LDA) to determine velocity distribution in large wind tunnels was developed and tested. The anemometer operates in backscattering mode with up to 2.30 m operating interval allowing positioning with a transverse fixture. Measurement is performed automatically in a 1 m x 1 m x 0.5 m field point area through a computer system. Three velocity components can be measured. High scattering of LDA data due to wall distance distortion through model variations is noted. Measurements in turbulent pipe flows were performed to assess accuracy. Results compared to pressure sensor readings show good agreement. The device can be applied to determine volume flows accurately and to give complete velocity profiles. ESA

N86-30966# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).

VELOCITY PRECISION MEASUREMENTS USING LASER DOPPLER ANEMOMETRY [PRAEZISIONSMESSUNGEN VON GESCHWINDIGKEITEN MITTELS LASER-DOPPLER-ANEMOMETRIE] c35

D. Dopheide, G. Taux, and L. Narjes *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 52-81 In GERMAN (For primary document see N86-30962 22-34)

Avail NTIS HC A20/MF A01

A Laser Doppler Anemometer (LDA) was calibrated to determine its applicability to high pressure measurements (up to 10 bars) for industrial purposes. The measurement procedure with LDA and the experimental computerized layouts are presented. The calibration procedure is based on absolute accuracy of Doppler frequency and calibration of interference strip intervals. A four-quadrant detector allows comparison of the interference strip distance measurements and computer profiles. Further development of LDA is recommended to increase accuracy (0.1% inaccuracy) and to apply the method industrially. ESA

N86-30967# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).

EUROPEAN ECONOMIC COMMUNITY (EEC) TEST STAND COMPARISON [VERGLEICH DER EG-PRUEFSTAENDE] c09

B. Harbrink *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 82-116 In GERMAN Original document contains color illustrations (For primary document see N86-30962 22-34)

Avail NTIS HC A20/MF A01

The accuracy of different EEC test stands is compared using gravimetry and volumetry for primary test stands, and dispersion methods for secondary test stands. The comparison shows a systematic relative inaccuracy of 0.3%. Laser Doppler Anemometry (LDA) could be used to measure volume stream with accuracy. An LDA high pressure test stand would allow direct calibration within a measurement range of 0 to 3000 cubic meter/hr with flow rate determined with 0.1% inaccuracy. ESA

N86-30968# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).

ACCURACY OF HIGH PRESSURE GAS METER CALIBRATION IN THE NETHERLANDS [GENAUIGKEIT DER HOCHDRUCK-GASZAEHLEREICHUNG IN DEN NIEDERLANDEN] c35

P. M. A. vanderKam *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 117-144 In GERMAN (For primary document see N86-30962 22-34)

Avail NTIS HC A20/MF A01

High pressure test facilities for industrial gas meters in the Netherlands are described. The calibration procedures and systems are presented. Gas compressibility effects on calibration and test facility accuracy are studied. Quality follow-up of the test facilities is described. ESA

N86-30969# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).

MEASUREMENT AND CALCULATION OF THE DENSITY OF NATURAL GASES [MESSUNG UND BERECHNUNG DER DICHTE VON ERDGASEN]

M. Jaeschke *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 144-186 In GERMAN (For primary document see N86-30962 22-34)

Avail: NTIS HC A20/MF A01

The density of natural gases is calculated from a state equation based on the AGA NX-19 calculation procedure, with 0.3% accuracy. The density is measured by weighing in laboratory with interferometric layout on a refraction index with an accuracy of 0.03% and with densitometers based on the oscillation procedure with variable accuracy according to the gases studied. The effects of the sonic velocity on the density measurement and their correction are described. With Solartron density cells, the sound dependency is compensated for by a thermal action on the spring constant of the oscillating system. Results with the densitometers show good agreement with the densities measured in the laboratory. ESA

N86-30970# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).

PRESSURE AND TEMPERATURE MEASUREMENTS ON NATURAL GASES ALONG ISOCHORES IN THE TECHNICALLY IMPORTANT STATE RANGING FROM 270 TO 300 K AND AT PRESSURES UP TO 60 BARS [P,T-MESSUNGEN AN ERDGASEN ENTLANG ISOCHOREN IM TECHNISCH WICHTIGEN ZUSTANDSBEREICH VON 270 K BIS 300 K UND BEI DRUECKEN BIS 60 BAR]

R. Weiss *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 187-204 In GERMAN (For primary document see N86-30962 22-34)

Avail: NTIS HC A20/MF A01

An isochoric test facility consisting of two pressure vessels, a thermostat, and fixtures for pressure and temperature measurement was used to calculate the gas density from pressure and temperature analytical data and measured values. The facility is analyzed for accuracy and to determine the virial factors for methane measured in a one-phase area. The composition of Ekofiskfeld natural gas samples is studied in a two-phase area based on measurement of the refraction index and of the expansion behavior. A simple state equation is used to compare measured values with the theoretical state parameters. Results show a relative inaccuracy of 2 per mill. The virial equation is applied to 4 other natural gases and shows good results for a temperature from 0 to 20 C and for a density up to 70 kg/C meter. ESA

N86-30971# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).

FIRST MEASUREMENTS WITH A LASER DOPPLER ANEMOMETER IN A HIGH PRESSURE NATURAL GAS PIPE [ERSTE MESSUNGEN MIT EINEM LASER-DOPPLER-ANEMOMETER IN EINER HOCHDRUCK-ERDGASLEITUNG]

D. Dopheide, G. Taux, and L. Narjes *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 205-228 In GERMAN (For primary document see N86-30962 22-34)

Avail: NTIS HC A20/MF A01

The applicability of Laser Doppler Anemometry (LDA) to velocity measurement in a natural gas pipe and the inaccuracy of the Doppler frequencies are studied. Test measurements show that the measuring procedure and the calibration methods can be applied at high pressure. The frequency inaccuracy is measured using a remote control programmable interference generator to obtain the signal-to-interference ratio required. The LDA emitting and receiving optics is studied, based on light particle forward scattering and backscattering for signal-to-interference ratio measurement. Bad signal quality due to high fluid velocity can be compensated for with higher laser performance. The frequency of the laser Doppler signals can be measured with an accuracy of 0.0001. ESA

N86-30972# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).

ORIFICE PLATE AND DIFFERENTIAL PRESSURE MEASUREMENT [BLENDEN- UND WIRKDRUCKMESSUNG]

W. Kerkmann *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 229-258 In GERMAN (For primary document see N86-30962 22-34)

Avail: NTIS HC A20/MF A01

The dynamics of the static pressure in the inlet distance of the plus and minus sides of a standard orifice plate with direct connection to a piezoelectric pressure indicator and along differential pressure pipes were studied. The static pressure is due to vortices and cavitation in the pipe. The dynamics of the outlet signal of the differential pressure transmitter was measured. The high pressure behavior of volume and turbine gas meters and of rotary lobe meters is discussed. ESA

N86-30973# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).

MODERN DIFFERENTIAL PRESSURE GAS COUNTER (WIGZ) MEASUREMENT [MODERNE WIRKDRUCK-GASZAEHLERMESSUNG] **c35**

O. Brandt *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 259-300 In GERMAN (For primary document see N86-30962 22-34)

Avail: NTIS HC A20/MF A01

The differential pressure gas counter facility developed to measure gas flow rate on orifice plates in the pipe system transporting Soviet gas to West Germany and France was equipped with small computers which record all the parameters of a measuring system and calculate the standard volume and the quantity of heat. These parameters are used to calibrate the facility. The differential pressure indicators and operating densitometers, the standard densitometers, pressure and temperature sensors, and calorific value indicators are described. The operation of and processing by the 16-bit microprocessor computers of all parameters are summarized. The central computer and the performance recording facility are presented. ESA

N86-30974# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).

PRACTICAL EXPERIENCES WITH HIGH PRESSURE (HP) GAS COUNTERS. PROBLEMS OF OPERATING CALIBRATION WITH HP [PRAKTISCHE ERFAHRUNGEN MIT HOCHDRUCK-GASZAEHLERN. PROBLEME DER BETRIEBSEICHUNG MIT HOCHDRUCK] **c35**

Buresch *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 301-314 In GERMAN (For primary document see N86-30962 22-34)

Avail: NTIS HC A20/MF A01

The experience gained in the use of lobed impeller meters in natural gas supply is reviewed. The problems arising from the application of turbine gas counters in high pres e measurement resulting from an unbalanced force ratio between the driving impulse of the flowing gas volume on the wheel and the frictional and inertial forces are presented. The financial and technical problems of calibration of counters for application at HP are reported. The European HP calibration test benches and the availability of accurate HP norms are discussed. ESA

N86-30975# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).

BEHAVIOR OF TURBINE WHEEL GAS COUNTERS AT HIGH PRESSURES [VERHALTEN VON TUR-

BINENRADGASZAEHLERN IM HOCHDRUCKBEREICH] c35
Dieter Schmitter *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 315-355 In GERMAN (For primary document see N86-30962 22-34)
Avail: NTIS HC A20/MF A01

The rpm rate of a turbine wheel gas meter rotor was used to determine the flow velocity of the gas. The behavior of the turbine wheel gas counters depends on the rpm measurement errors, on the total pressure loss in the counter and on the flow axial force in high pressure pipes. The forces and moments on the measuring wheel, the flow resistance, and the optimal layout of a flow channel are described. The HP deviations depend on the Reynolds number and the resonance sensitivity. A neutral behavior of the turbine can be achieved by optimizing the manufacture and installation. ESA

N86-30976# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
PRIMARY MEASUREMENT [PRIMAERE MESSUNG]
Fischer *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 356-368 In GERMAN (For primary document see N86-30962 22-34)
Avail: NTIS HC A20/MF A01

The economical aspects of accurate gas measurement with orifice plates and turbine gas counters are reviewed. The economical application of test benches and facilities for analysis and calibration of the counters is discussed. Vortex and supersonic counters are investigated for long-time stability and repeatability as well as the effects of the installation methods. Cost-to-accuracy analysis of the measuring instruments and the flow computers for automatic temperature and pressure correction and for calculation of the gas compressibility is reported. The introduction of computer monitoring of the entire pipe system and of an information system is presented. ESA

N86-30977# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
MEASUREMENT OF SMALL PRESSURE DIFFERENCES AT A HIGH STATIC PRESSURE [MESSUNG KLEINER DRUCKDIFFERENZEN BEI HOHEM STATISCHEN DRUCK]
G. Klingenberg *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 369-390 In GERMAN (For primary document see N86-30962 22-34)
Avail: NTIS HC A20/MF A01

Test procedures using differential pressure transducers are presented. The effects of static pressure on measurement accuracy are studied. The effects of heating, time, resistance, and interference voltages on the transducers are presented and the ripple of the outlet parameter is determined. The results show voltage displacement, temperature hysteresis, and a calibration error greater than 0.3%. Float-type pressure gages, double piston gages, and fluid gages are tested. All measures show that no pressure difference greater than 12 Pa appears with the static pressure increasing to 8 MPa. ESA

N86-30978# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
INFLUENCE OF THE FORM OF THE VORTEX BODIES ON THE TECHNICAL PERFORMANCE OF A VORTEX METER [EINFLUSS DER WIRBELKOERPERFORM AUF DAS MESSTECHNISCHE VERHALTEN DER WIRBELDURCHFLUSSMESSER]
H.-G. Kalkhof *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 391-407 In GERMAN (For primary document see N86-30962 22-34)
Avail: NTIS HC A20/MF A01

The performance of the vortex meter is reviewed. The measuring properties of the vortex meter depend on the behavior of the Strouhal, Reynolds, and Mach numbers. The vortex cavitation frequency is measured with an isothermal hot-film anemometer. Vortex bodies with T and delta profiles are studied by measuring the signal frequency period. The body thickness and length and the Reynolds number influence the Strouhal number and the relative standard difference of the period. Results are compared with measurements with a differential pressure flowmeter. The pressure loss of the vortex meter is smaller than that of the orifice plate, equal to that of the nozzle, and greater than that of the venturi nozzle. ESA

N86-30979# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
EFFECTS OF PREVIOUS DISTURBANCES ON THE METER FACTORS OF A VORTEX METER [EINFLUESS VON VORSTOERUNGEN AUF ZAEHLERFAKTOREN VON WIRBELZAEHERN] c35
J. Boehm *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 408-428 In GERMAN (For primary document see N86-30962 22-34)
Avail: NTIS HC A20/MF A01

Pulsations (100 to 120 dB) generated by a pressure chamber amplifier are studied to determine their effects on the vortex meter. The vortex meter is disturbed when the pulsating frequency is in phase with the vortex cavitation frequency. Perturbations in the velocity profile through curvatures and slide valves lead to meter factor displacement. The residual angular momentum vectors behind a bundle of pipes and behind the aperture plates are in opposite directions. The effects of a chamber curvature without and with the installation of a rectifier are presented. Gas density indicators are used to study the gas type influence with a bifurcated oscillator and a pipe oscillator. The pressure differences depend on the oscillating and sonic velocity and on the gas density. The gas type influence can be corrected by reducing the oscillating velocity of the structure and by applying the error difference of two density indicators with differential oscillating velocity. ESA

N86-30980# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
VORTEX GAS COUNTER TYPE WBZ 08. PRACTICAL EXPERIENCE [WIRBELGASZAEHLER TYP WBZ 08 - PRAXISERFAHRUNGEN] c35
Hans-Juergen Kastner *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 429-444 In GERMAN (For primary document see N86-30962 22-34)
Avail: NTIS HC A20/MF A01

The performance of the vortex gas counter type WBZ 08 is reviewed. The counter consists of vortex bodies with T profiles, a thermistor for vortex scanning, and an electronic monitoring unit. Error curves from low and high pressure test benches show a measurement accuracy of 0.3%. The vortex gas counter shows good robustness, stability and reproductibility. The theoretical self-cleaning of the vortex bodies through vortex cavitation is confirmed. The theoretical counter factors show good agreement with the ones measured through dry calibration. The functional error safety of the entire measuring facility can be optimized by connecting flow computers. ESA

N86-30981# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
THE GAS MEASURING BELL: A BASIC NORMAL EQUIPMENT FOR THE REPRESENTATION OF VOLUME UNIT FOR GASES [DIE GASMESSGLOCKE - EIN BASISNORMALGERAET ZUR DARSTELLUNG DER VOLUMENEINHEIT FUER GASE] c35
H. Brunnemann and A. Aschenbrenner *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 445-449 In GERMAN (For primary document see N86-30962 22-34)
Avail: NTIS HC A20/MF A01

A 1 cubic meter gas meter was used to determine the volume unit. A bell cylinder sinks into spindle oil used as a sealing liquid in a bell tank, which causes compression of an air volume. The volume is determined by a geometrical measurement of the bell cylinder along six mantle lines. A table gives the bell volume at 5 mm intervals. The intermediate values can be determined accurately through interpolation. The bell position is determined with an optoelectronic distance indicator with a resolution of 0.01 mm. The conversion of the compressed air

volume to the testpiece can be done with pressure and temperature measurements at different points of the bell and of the testpiece. Evaluation of the measurements is done with a microcomputer. The BASIC software allows the state-dependent calculation of the gas volume, and the representation of the testpiece error curves. A reproductibility of 0.03% and a measuring inaccuracy of the bell of 0.1% are achieved. ESA

N86-30982# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
A NEW METHOD FOR THE DETERMINATION OF STATIONARY MASS FLOW RATES OF GASES [NEUARTIGES VERFAHREN ZUR BESTIMMUNG STATIONAERER MASSESTROEME VON GASEN]
L. Narjes and M. Zander *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 450-452 In GERMAN; ENGLISH summary (For primary document see N86-30962 22-34)
Avail: NTIS HC A20/MF A01

The feasibility of a one-step connection of gas measuring instruments was studied. The method consists of a pressure regulator, the gas counter to be checked, a nozzle, and a charging vessel. The method is based on the enthalpy differential equation of the first law of thermodynamics for an open adiabatic system with time-dependent variation of the quantity of energy. Thermostatting of the charging vessel is studied. The method allows instantaneous, dynamic measurement acquisition. ESA

N86-30983# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS
1986 419 p Lecture Series held in Rhode-Saint-Genese, Belgium, 13-17 Jan. 1986
(VKI-LS-1986-01; ESA-86-97481) Avail: NTIS HC A18/MF A01

Boundary layer equations; the finite element method in computational fluid dynamics; and implicit time dependent methods for inviscid and viscous compressible flows are introduced. For individual titles, see N86-30984 through N86-30987.

N86-30984# Maryland Univ., College Park.
COMPUTATIONAL FLUID DYNAMICS, INTRODUCTION
John D. Anderson *In* Von Karman Inst. for Fluid Dynamics Introduction to Computational Fluid Dynamics 1986 269 p (For primary document see N86-30983 22-34)
Avail: NTIS HC A18/MF A01

The philosophy and power of computational fluid dynamics; the governing equations; solution techniques; and the vocabulary of the discipline are introduced. Low speed incompressible flow to hypersonic flow is covered. ESA

N86-30985# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
BOUNDARY LAYER EQUATIONS AND METHODS OF SOLUTION
R. Grundmann *In its* Introduction to Computational Fluid Dynamics 1986 31 p (For primary document see N86-30983 22-34)
Avail: NTIS HC A18/MF A01

Laminar boundary layer theory, starting from Prandtl's ideas is described. The hierarchy of the boundary layer equations is discussed, and the relationship of the different types of boundary layer equations to the Navier-Stokes equations is demonstrated. Transformation techniques to reduce the problems of solution are indicated. A generalized discretization scheme is applied to a set of laminar compressible boundary layer equations and a numerical solution scheme for calculating the remaining tridiagonal linear difference equations is shown. A laminar boundary layer along the symmetry line of a highly inclined ellipsoid is calculated. ESA

N86-30986# Ghent Univ. (Belgium).
THE FINITE ELEMENT METHOD IN FLUID MECHANICS
E. Dick *In* Von Karman Inst. for Fluid Dynamics Introduction to Computational Fluid Dynamics 1986 38 p (For primary document see N86-30983 22-34)
Avail: NTIS HC A18/MF A01

Elliptic partial differential equations encountered in fluid mechanics boundary value problems are introduced. Finite element method applications to steady compressible and incompressible potential flow, and steady incompressible Navier-Stokes equations are illustrated. ESA

N86-30987# Sherbrooke Univ. (Quebec).
IMPLICIT TIME DEPENDENT METHODS FOR INVISCID AND VISCOUS COMPRESSIBLE FLOWS
G. Degrez *In* Von Karman Inst. for Fluid Dynamics Introduction to Computational Fluid Dynamics 1986 61 p (For primary document see N86-30983 22-34)
Avail: NTIS HC A18/MF A01

Generalizations to partial differential equations of linear multistep methods for the compressible Euler and Navier-Stokes equations are introduced. The one step predictor/corrector scheme, an implicit extension of the explicit MacCormack scheme, is presented. Single step schemes with centered differencing in space are described. Characteristic modeling schemes for the Euler equations, i.e., schemes featuring noncentered discretization in space, are outlined. ESA

N86-30988# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
NUMERICAL TECHNIQUES FOR VISCOUS FLOW CALCULATIONS IN TURBOMACHINERY BLADINGS
1986 516 p Lecture Series held in Rhode-Saint-Genese, Belgium, 20-24 Jan. 1986
(VKI-LS-1986-02; ESA-86-97482) Avail: NTIS HC A22/MF A01

Governing equations and solution methods of Navier-Stokes equations; numerical modeling of Navier-Stokes equations; turbulence models; grid generation systems in turbomachinery; Navier-Stokes computations for circulation controlled airfoils and exotic airfoils; multigrid convergence acceleration techniques for explicit Euler solvers and applications to Navier-Stokes calculations; and application of full Navier-Stokes solvers to turbomachinery flow problems were discussed. For individual titles, see N86-30989 through N86-30998. ESA

N86-30989# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
GOVERNING EQUATIONS
R. Grundmann *In its* Numerical Techniques for Viscous Flow Calculations in Turbomachinery Bladings 1986 19 p (For primary document see N86-30988 22-34)
Avail: NTIS HC A22/MF A01

The inviscid Euler equations are discussed by transporting viscous flow properties, and a hierarchy of the boundary layer equations is evaluated for a steady, compressible, laminar flow over a two dimensional curved surface by an order-of-magnitude analysis. The gap between the second order boundary layer theory and the full viscous equations is closed by mentioning the Reynolds averaged Navier-Stokes equations, the thin shear layer approximation, the parabolic approximation and the viscid-inviscid interaction. ESA

N86-30990# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
SOLUTION METHOD OF PARABOLIZED NAVIER-STOKES EQUATIONS
R. Grundmann *In its* Numerical Techniques for Viscous Flow Calculations in Turbomachinery Bladings 1986 22 p (For primary document see N86-30988 22-34)
Avail: NTIS HC A22/MF A01

Laminar and turbulent incompressible flow through curved channels is studied via artificially parabolized Navier-Stokes equations. It is shown how the laminar secondary flow develops if at the inlet of a streamwise curved channel a rigid body vortex moving in the cross section is prescribed. For low Reynolds numbers where no separation is expected, the fully parabolic Navier-Stokes equations can be applied. Using a grid spacing of 21 x 21 points in the cross flow section, the computer time needed

for one calculation is less than 30sec on a Cray-1S. A solution method for engineering purposes to calculate turbulent flows in curved three dimensional ducts with variable cross sections was developed. Calculation time on the Cray-1S (21 x 21 grid) is less than 48 sec. ESA

N86-30991# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
NUMERICAL MODELING OF NAVIER-STOKES EQUATIONS
M. Borsboom *In its* Numerical Techniques for Viscous Flow Calculations in Turbomachinery Bladings 1986 67 p (For primary document see N86-30988 22-34)
Avail: NTIS HC A22/MF A01

It is argued that the relative magnitude of the truncation error rather than the order of accuracy of a discretization scheme determines how well a solution procedure predicts the solution of a system of differential equations. For the numerical simulation of the Navier-Stokes equations at high Reynolds number, this means that only a very small amount of numerical diffusion can be tolerated in regions where the viscous effects are relatively important. A technique using artificial diffusion, in the form of turbulent viscosity, to damp out high frequency modes of solution where a high concentration of grid points is not available, is outlined. The method is extended to blade-to-blade flow calculations and unsteady calculations. The time derivative is considered as a part of the source term, and is discretized in space using a trapeziodal rule. The discretization scheme combines high accuracy on a wide variety of grid structures with ease of programming, as is demonstrated by the calculation of the flow over a backward facing step, where excellent results are obtained using a highly distorted grid. storted grid. ESA

N86-30992# Lyon-1 Univ. (France). Lab. de Mecanique des Fluides.
TURBULENCE MODELS
J. P. Bertoglio, B. Gay, and J. N. Gence *In* Von Karman Inst. for Fluid Dynamics Numerical Techniques for Viscous Flow Calculations in Turbomachinery Bladings 1986 62 p (For primary document see N86-30988 22-34)
Avail: NTIS HC A22/MF A01

Statistical and space averaging approaches to turbulence modeling in rotating machines are reviewed. Ways in which to devise closure relations in turbulence modeling are outlined. Two-point closures and large eddy simulation are treated. ESA

N86-30993# Ecole Polytechnique, Montreal (Quebec).
INTRODUCTION TO GRID GENERATION SYSTEMS IN TURBOMACHINERY
R. Camarero, B. Ozell, M. Reggio, and A. Caron *In* Von Karman Inst. for Fluid Dynamics Numerical Techniques for Viscous Flow Calculations in Turbomachinery Bladings 1986 75 p (For primary document see N86-30988 22-34)
Avail: NTIS HC A22/MF A01

Body-fitted curvilinear grid generation for the numerical simulation of three dimensional flow in turbomachines is introduced. The grids yield coordinate curves aligned with the domain boundaries. The numerical scheme for the governing equations is carried out on a rectangular mesh, giving a simpler and more accurate algorithm since bondaries coincide with coordinate grids, and no interpolation is required. The geometric complexity, through the transformation, is imbedded into the coefficients of the governing equations, affording the possibility of writing generalized codes applicable to a variety of geometries. This results in a great saving in the code development effort. ESA

N86-30994# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFICIENT SOLUTION METHODS FOR THE NAVIER-STOKES EQUATIONS
Thomas H. Pulliam *In* Von Karman Inst. for Fluid Dynamics Numerical Techniques for Viscous Flow Calculations in Turbomachinery Bladings 1986 104 p (For primary document see N86-30988 22-34)
Avail: NTIS HC A22/MF A01

Implicit finite difference schemes for solving two-dimensional and three-dimensional Euler and thin layer Navier-Stokes equations are addressed. The methods are demonstrated in fully vectorized codes for a Cray type architecture. The Beam and Warming implicit approximate factorization algorithm in generalized coordinates is used. The methods are either time accurate or accelerated non-time accurate steady state schemes. Acceleration and efficiency modifications such as matrix reduction, diagonalization, and flux split schemes are presented. Two dimensional inviscid and viscous calculations (e.g., airfoils with a deflected spoiler, circulation control airfoils, and unsteady buffeting) and of three dimensional viscous elliptical bodies, exhausting boattails, and generic oblique wing computations are discussed. ESA

N86-30995# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NAVIER-STOKES COMPUTATIONS FOR CIRCULATION CONTROLLED AIRFOILS
Thomas H. Pulliam, Dennis C. Jesperen, and Timothy J. Barth *In* Von Karman Inst. for Fluid Dynamics Numerical Techniques for Viscous Flow Calculations in Turbomachinery Bladings 1986 18 p Presented at 18th AIAA Fluid Dynamics and Plasmadynamics and Lasers Conference, Cincinnati, Ohio, 16-18 Jul. 1985 (For primary document see N86-30988 22-34)
(AIAA-85-1587) Avail: NTIS HC A22/MF A01

Navier-Stokes computations of subsonic to transonic flow past airfoils with augmented lift due to rearward jet blowing over a curved trailing edge are presented. The approach uses a spiral grid topology. Solutions are obtained using a Navier-Stokes code which employs an implicit finite difference method, an algebraic turbulence model, and developments which improve stability, convergence, and accuracy. Results are compared against experiments for no jet blowing and moderate jet pressures and demonstrate the capability to compute these complicated flows. ESA

N86-30996# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NAVIER-STOKES COMPUTATIONS FOR EXOTIC AIRFOILS
Timothy J. Barth (Informatics General Corp., Palo Alto, Calif.), Thomas H. Pulliam, and Peiter G. Buning *In* Von Karman Inst. for Fluid Dynamics Numerical Techniques for Viscous Flow Calculations in Turbomachinery Bladings 1986 17 p Presented at 23rd AIAA Aerospace Science Meeting, Reno, Nev., 14-17 Jan. 1985 (For primary document see N86-30988 22-34)
(AIAA-85-0109) Avail: NTIS HC A22/MF A01

A hyperbolic grid generator with improvements for handling sharp corners and concave surfaces combined with a Navier-Stokes flow solver is applied to complex two dimensional airfoil configurations. Steady separated flow about an iced leading edge of an airfoil is presented. Unsteady viscous separated flows past an airfoil at two angles of attack with a spoiler deployed at 60 deg are compared with experiment. The spoiler computations are performed with two different topological maps of the physical domain to the computational domain. Graphical techniques for the static and unsteady display of the flow fields are discussed. ESA

N86-30997# United Technologies Corp., East Hartford, Conn.
MULTIGRID CONVERGENCE ACCELERATION TECHNIQUES FOR EXPLICIT EULER SOLVERS AND APPLICATIONS TO NAVIER-STOKES CALCULATIONS
Ron-Ho Ni *In* Von Karman Inst. for Fluid Dynamics Numerical Techniques for Viscous Flow Calculations in Turbomachinery Bladings 1986 61 p (For primary document see N86-30988 22-34)
Avail: NTIS HC A22/MF A01

The power of the multiple-grid technique in improving the rate of convergence for Euler and Navier-Stokes calculations for turbomachinery applications is shown. The classical multigrid method development and solution algorithms are reviewed to provide a better understanding of the origin of the multigrid

convergence acceleration techniques. Jameson's (1983) application of the classical multigrid solution algorithm and construction of the formal multigrid technique to gain significant improvements in the computational efficiency from an explicit time-marching procedure for solving the Euler flow equations are described. ESA

N86-30998# Cambridge Univ. (England). Whittle Lab.
APPLICATION OF FULL NAVIER-STOKES SOLVERS TO TURBOMACHINERY FLOW PROBLEMS
W. N. Dawes *In* Von Karman Inst. for Fluid Dynamics Numerical Techniques for Viscous Flow Calculations in Turbomachinery Bladings 1986 56 p (For primary document see N86-30988 22-34)
Avail: NTIS HC A22/MF A01

The design of computer codes for the solution of the equations of three dimensional viscous compressible flow in turbomachinery is discussed. The form of the governing equations and the modeling of the effects of turbulence; the computational mesh; discretization methodology; discretization of the governing equations; the form and implementation of the boundary conditions; iterative solution of the discretized equations; and the form of artificial dissipation added are considered. ESA

N86-30999*# Aeronautical Research Associates of Princeton, Inc., N. J.
A FUNDAMENTAL STUDY OF DRAG AND AN ASSESSMENT OF CONVENTIONAL DRAG-DUE-TO-LIFT REDUCTION DEVICES
John E. Yates and Coleman duP. Donald Washington NASA Sep. 1986 34 p
(Contract NAS1-18065)
(NASA-CR-4004; NAS 1.26:4004; ARAP-577) Avail: NTIS HC A03/MF A01 CSCL 20D

The integral conservation laws of fluid mechanics are used to assess the drag efficiency of lifting wings, both CTOL and various out-of-plane configurations. The drag-due-to-lift is separated into two major components: (1) the induced drag-due-to-lift that depends on aspect ratio but is relatively independent of Reynolds number; (2) the form drag-due-to-lift that is independent of aspect ratio but dependent on the details of the wing section design, planform and Reynolds number. For each lifting configuration there is an optimal load distribution that yields the minimum value of drag-due-to-lift. For well designed high aspect ratio CTOL wings the two drag components are independent. With modern design technology CTOL wings can be (and usually are) designed with a drag-due-to-lift efficiency close to unity. Wing tip-devices (winglets, feathers, sails, etc.) can improve drag-due-to-lift efficiency by 10 to 15% if they are designed as an integral part of the wing. As add-on devices they can be detrimental. It is estimated that 25% improvements of wing drag-due-to-lift efficiency can be obtained with joined tip configurations and vertically separated lifting elements without considering additional benefits that might be realized by improved structural efficiency. It is strongly recommended that an integrated aerodynamic/structural approach be taken in the design of (or research on) future out-of-plane configurations. Author

N86-31000*# Mechanical Technology, Inc., Latham, N. Y.
PERFORMANCE OF OIL PUMPING RINGS: AN ANALYTICAL AND EXPERIMENTAL STUDY Final Report
M. W. Eusepi, J. A. Walowit, O. Pinkus, and P. Holmes Jan. 1986 233 p
(Contracts DEN3-256; DE-AI01-85CE-50112)
(NASA-CR-175083; DOE/NASA-0256/1; NAS 1.26:175083; MTI-86TR17) Avail: NTIS HC A11/MF A01 CSCL 20D

A steady-state design computer program was developed to predict the performance of pumping rings as functions of geometry, applied loading, speed, ring modulus, and fluid viscosity. Additional analyses were developed to predict transient behavior of the ring and the effects of temperature rises occurring in the hydrodynamic film between the ring and shaft. The analysis was initially compared with previous experimental data and then used to design additional rings for further testing. Tests were performed with Rulon, carbon-graphite, and babbit rings. The design analysis was used to size all of the rings and to select the ranges of clearances, thickness, and loading. Although full quantitative agreement was lacking, relative agreement existed in that rings that were predicted to perform well theoretically, generally performed well experimentally. Some causes for discrepanices between theory and experiment are believed to be due to starvation, leakage past the secondary seal at high pressures, and uncertainties in the small clearances and local inlet temperatures to the pumping ring. A separate preliminary analysis was performed for a pumping Leningrader seal. This anlaysis can be used to predict the film thickness and flow rate thr ough the seal as a function of pressure, speed, loading, and geometry. M.G.

N86-31001*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.
APPLICATION OF A LOW ORDER PANEL METHOD TO COMPLEX THREE-DIMENSIONAL INTERNAL FLOW PROBLEMS Interim Report
Dale L. Ashby and Doral R. Sandlin Dec. 1985 100 p
(Contract NCC2-226)
(NASA-CR-179656; NAS 1.26:179656) Avail: NTIS HC A05/MF A01 CSCL 20D

An evaluation of the ability of a low order panel method to predict complex three-dimensional internal flow fields was made. The computer code VSAERO was used as a basis for the evaluation. Guidelines for modeling internal flow geometries were determined and the effects of varying the boundary conditions and the use of numerical approximations on the solutions accuracy were studied. Several test cases were run and the results were compared with theoretical or experimental results. Modeling an internal flow geometry as a closed box with normal velocities specified on an inlet and exit face provided accurate results and gave the user control over the boundary conditions. The values of the boundary conditions greatly influenced the amount of leakage an internal flow geometry suffered and could be adjusted to eliminate leakage. The use of the far-field approximation to reduce computation time influenced the accuracy of a solution and was coupled with the values of the boundary conditions needed to eliminate leakage. The error induced in the influence coefficients by using the far-field approximation was found to be dependent on the type of influence coefficient, the far-field radius, and the aspect ratio of the panels. Author

N86-31002# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Mathematics.
[THE NUMERICAL SOLUTION OF THE NAVIER-STOKES EQUATIONS FOR INCOMPRESSIBLE FLOWS AND THE APPLICABILITY OF THE STREAM FUNCTION FORMULATION OF THE NAVIER-STOKES EQUATIONS] Final Report, for 1 Jun. 1982 - 30 Jun. 1985
R. A. Nicolaides Dec. 1985 4 p
(Grant AF-AFOSR-0213-82)
(AD-A166061; AFOSR-86-0070TR) Avail: NTIS HC A02/MF A01 CSCL 20/4

This effort was focused on basic work on the numerical solution of the Navier-Stokes equations for incompressible flows. A basic problem in this theory is the compatibility of the finite element space used to approximate the pressure field. The investigator was able to devise a simple test of the finite element space. An inspection of the solution to this linear system immediately reveals whether the proposed scheme is stable. A second area of activity was an investigation of the applicability of the stream function formulation of the Navier-Stokes equations. This effort resulted in a number of publications in the scientific literature. GRA

N86-31003# Air Force Armament Lab., Eglin AFB, Fla.
AN EVALUATION OF A PARABOLIZED NAVIER-STOKES (PNS) CODE FOR CONE-CYLINDER-FLARED CONFIGURATIONS Final Report, Oct. 1982 - May 1984
Charles J. Cottrell and Gary T. Chapman Apr. 1986 10 p
Previously announced in IAA as A84-42361
(AD-A166650; AFATL-TR-86-16) Avail: NTIS HC A02/MF A01

CSCL 20/4

A Parabolized Navier-Stokes (PNS) code's capability to predict the onset of laminar and turbulent boundary layer separation, forces, moments, and pressure distributions was investigated. Predictions of incipient separation show good agreement with experimental results. Force and moment calculations were found to agree favorably with experimental data for a wide range of geometries for mach numbers from 2 to 4 with turbulent boundary layers. Limited comparison of pressure distribution data also showed good agreement. Skin friction and Stanton number calculations are presented to indicate the code's capability to calculate this information and hence, provide a complete data base for attached flow conditions. The sensitivity of these calculations to smoothing and marching parameter variations was examined and found to be acceptable for most design work. The code was found to be suitable to complement or reduce wind tunnel experimentation for the design of this class of configuration with regard to accuracy, cost and usability. GRA

N86-31004# Exotech, Inc., Campbell, Calif.
FLOW MEASUREMENTS IN A CENTRIFUGAL DIFFUSOR TEST DEVICE Final Report, 1 Oct. 1984 - 31 May 1985
Thomas Vitting Jun. 1985 134 p
(Contract N00014-84-C-0766)
(AD-A166758; TR-8501) Avail: NTIS HC A07/MF A01 CSCL 13/7

This work sought to verify concepts used in the design of a large scale, low speed, radial cascade wind tunnel which was to be used to investigate flow phenomena in and the performance of vaned radial diffusors. A major contributor to centrifugal compressor efficiency is the performance of the vaned diffusor which closely follows the impeller of the compressor. The purpose of this diffusor is to efficiently convert most of the kinetic energy of the transonic flow entering the vane into pressure. The need for an experimental facility which could simulate adequately, at low cost and in a controlled way, the environment of the centrifugal compressor motivated the development of the Centrifugal Diffusor Test Device (CDTD). It was expected that the generation of a three dimensional flow would provide improved empirical data on annular cascade performance. This measurement program surveyed the axial and circumferential uniformity of the flow at the inlet of a transonic wedge-type blading mounted in the device. Evaluation of the results showed the flow uniformity to be unsatisfactory. Leakage and other small perturbations in the flow field in the swirl generator are believed to be amplified by the basic flow configuration of the device. GRA

N86-31005# Exotech, Inc., Campbell, Calif.
WAVE ROTOR RESEARCH: A COMPUTER CODE FOR PRELIMINARY DESIGN OF WAVE DIAGRAMS Final Report, 1 Oct. 1984 - 31 May 1985
Atul B. Mathur Jun. 1985 71 p
(Contract N00014-84-C-0766)
(AD-A166760; TR-8502) Avail: NTIS HC A04/MF A01 CSCL 20/4

A one-dimensional Euler code for solving the unsteady, inviscid, compressible flow in wave rotor devices is described. The Random Choice Method program (RCM) implemented in the code is shown to be very suitable for describing the multiple discontinuities and wave interactions in these flows. The modular structure of the program allows studying different families of wave diagrams quickly and inexpensively. Example applications are included.
Author (GRA)

N86-31006# Iowa Univ., Iowa City. Inst. of Hydraulic Research
EQUATIONS OF LAMINAR AND TURBULENT FLOWS IN GENERAL CURVILINEAR COORDINATES Technical Report, Nov. 1985 - Feb. 1986
M. C. Richmond, H. C. Chen, and V. C. Patel Feb. 1986 86 p
(Contract N00014-83-K-0136)
(AD-A166837; AD-E950814; IIHR-300) Avail: NTIS HC A05/MF A01 CSCL 20/4

Recent developments in computational fluid mechanics and grid generation have made it possible to consider complex three dimensional laminar and turbulent flows using nonorthogonal coordinates. However, the necessary equations in generalized nonorthogonal coordinates are not readily available in a single reference. The purpose of this report is to present these equations for an incompressible fluid. Methods of curvilinear tensor analysis are used to develop the most commonly used equations. Their relationship with the more familiar equations in orthogonal coordinates is shown. Finally, the practical problems of evaluating the many geometric coefficients which appear in these equations are examined by considering numerically generated coordinates for flow around three dimensional bodies. GRA

N86-31007# Naval Ship Research and Development Center, Bethesda, Md.
ERGODICITY AND MIXING IN A FIVE-MODE SPECTRAL MODEL OF TWO-DIMENSIONAL TURBULENCE Final Report
M. C. Mosher Apr. 1986 29 p
(AD-A166922; DTNSRDC-86/009) Avail: NTIS HC A03/MF A01 CSCL 20/4

A dynamical system derived by truncating to five frequencies a Fourier representation of the Euler equations for incompressible, two dimensional fluid flow is investigated. In using Fourier representations to model turbulence, investigators have assumed that the truncated systems are ergodic and mixing, although the validity of this assumption is an open question. The truncated Fourier system has seven independent constants of motion which define a three dimensional torus. Since a component of the solution to the system is quasiperiodic, the flow of the system can never be mixing and, in particular, cannot be mixing on the three dimensional tours defined by the constants of motion. GRA

N86-31008# Office of Naval Research, London (England).
TURBULENT SHEAR-LAYER/SHOCK-WAVE INTERACTION Conference Report
Eugene F. Brown 1 Apr. 1986 10 p Presented at the Symposium of the International Union of Theoretical and Applied Mechanics on Turbulent Shear-Layer/Shock-Wave Interactions, Palaiseau, France
(AD-A166934; ONRL-C-2-86) Avail: NTIS HC A02/MF A01 CSCL 20/4

This report reviews presentations given at the September 1985 symposium of the International Union of Theoretical and Applied Mechanics and concludes that calculation of two-dimensional shock-wave/boundary-layer interaction problems is advancing well. For three-dimensional flows, accurate numerical calculation needs more experimental data to clarify the mechanisms and flow structures involved. Of greatest priority in this area is obtaining accurate unsteady measurements so that the mechanisms of shock oscillation and its results on the flow field can be better understood. GRA

N86-31009# Office of Naval Research, London (England).
THE 6TH GAMM (GESELLSCHAFT FUER ANGEWANDTE MATHEMATIK UND MECHANIK) CONFERENCE ON NUMERICAL METHODS IN FLUID MECHANICS Conference Report
Eugene F. Brown 1 Apr. 1986 8 p Conference presented at Goettingen, West Germany, 25-27 Sep. 1985
(AD-A166960; ONRL-C-1-86) Avail: NTIS HC A02/MF A01 CSCL 20/4

Presentations as aero-acoustic modeling, transition control, vortex shedding, domain decomposition methods, TVD (Total Variation Diminishing) calculations, viscous/inviscid interaction, and Euler solutions are reviewed. Papers dealing with methods (in contrast with applications) were stressed at this meeting. GRA

N86-31010# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
THREE-DIMENSIONAL SHOCK WAVE AND TURBULENT BOUNDARY LAYER INTERACTIONS Final Report, 1 Aug. 1981 - 31 Jul. 1984
Seymour M. Bogdonoff Sep. 1985 75 p
(Contract F49620-81-K-0018)

(AD-A167086; Rept-1723-MAE; AFOSR-85-1242TR) Avail: NTIS HC A04/MF A01 CSCL 20/4

An extensive experimental study of three-dimensional shock wave turbulent boundary layer interactions caused by shock generators defined solely by angles has been carried out at Mach 3. Sharp fins, sharp swept fins, swept wedges, and semicones have been used to generate a wide range of shock waves. The interaction of these waves with turbulent boundary layers has been investigated by surface flow visualization, mean surface static pressure distributions, flowfield surveys of total pressure and yaw, and several flowfield visualization techniques. Some exploratory high frequency surface pressure measurements have been carried out to evaluate the steadiness of these interactions. Scaling laws for both surface and flowfield features have been derived. Some limited studies were carried out at a Mach number of 2. A flowfield study has shown that the initial part of interactions caused by the same strength and geometrical shock wave generated by different shock generators are all similar. The footprints of the interactions, as shown by surface flow visualization, can be categorized as approximately conical or cylindrical, and the boundaries between these two regions have been defined for both Mach 3 and Mach 2. There are still questions with regards to the detailed flowfield structures and physical mechanisms, but the three-dimensional interactions appeared to be less unsteady than that of two-dimensional separated flows. GRA

N86-31011# Abramovich (Shaul), Haifa (Israel).
GAS DYNAMICS OF LASER EXHAUST EXTERNAL TO SPACECRAFT
Shaul Abramovich Nov. 1985 118 p
(Contract N62271-83-M-1939; DARPA Order 4573)
(AD-A167143; NPS-67-84-006CR) Avail: NTIS HC A06/MF A01 CSCL 20/4

Some procedures have been developed to analyze the flowfield of highly underexpanded axisymmetric ring jets operated at high altitudes. The Method of Characteristics (MOS) was used to compute the Prandtl Meyer expansion fan and flow parameters in that region. The MOC may also be used to obtain some indications about the repetitive expansion compression behavior of the jet as well as the divergent shape of the compression part downstream, when the ambient pressure goes below certain limits. The continuum methods may be used as far as the limit where translational equilibrium ceases to exist. The breakdown of the continuum theory may be evaluated using the experimental breakdown parameter. Beyond this limit, the molecular Direct-Simulation-Monte-Carlo method (DSMC) is applied. The axisymmetric Monte Carlo Simulation begins outside the nozzle, where the breakdown parameter has a value of approximately 0.05. The actual shape of this breakdown limit is a closed lobe surface which starts at the nozzle lips, approximately follows a specific Mach wave in the Prandtl Meyer fan and closes back to the axis far downstream. Because our interest is limited to the close vicinity of the corners, there the shape of this limit may be approximated to a straight line (for an axisymmetric flow making cone). GRA

N86-31012# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
BURSTS AND PRESSURE FLUCTUATIONS IN TURBULENT BOUNDARY LAYERS Final Report, Nov. 1984 - Nov. 1985
P. Bradshaw and J. F. Morrison Jan. 1986 52 p
(Contract DAJA45-84-C-0049; DA Proj. 1L1-61102-BH-57)
(AD-A167186) Avail: NTIS HC A04/MF A01 CSCL 20/4

Surface pressure fluctuations below turbulent boundary layers were studied, in part, because they can be regarded as footprints of passing turbulent eddies. The pressure fluctuations are formally described by a Poisson equation, implying that the pressure fluctuation at a given point is mathematically represented by the integral of a source term over the whole flow field, with a weighting inversely proportional to the distance of the source from the given point. In turbulent boundary layers, fluctuations were made in a low-speed constant pressure the high-frequency part of the wall pressure fluctuations is generated mainly within the inner layer - say, the first 20% of the boundary layer thickness - and the low-frequency part is generated mainly in the outer layer. Measurements of velocity and surface-pressure turbulent boundary layer well downstream of an extensive region of wall roughness. The turbulence near the wall was representative of a smooth-wall flow, while that in the outer layer was typical of the upper stream rough-wall flow. Comparison with previous measurements on an entirely smooth wall illustrates the relative contributions of the inner and outer layers to the surface pressure fluctuations. GRA

N86-31013# Lawrence Livermore National Lab., Calif.
MAP MODELS OF THE TRANSITION TO TURBULENCE IN TWO AND THREE DIMENSIONAL PIPE FLOW
J. A. Viecelli 3 Feb. 1986 42 p
(Contract W-7405-eng-48)
(DE86-006842; UCID-20661) Avail: NTIS HC A03/MF A01

Couette flow, at least when the outer cylinder is fixed, seems to be yielding gradually to theoretical analysis, but Couette flow with the outer cylinder rotating, and Poiseuille flow are still not well understood. These latter cases exhibit a snap transition from laminar to turbulent flow which is not well explained by traditional theory. Certainly, the predictions of linearized stability theory do not agree with observed transition Reynolds numbers, and although a number of nonlinear theories have evolved, they have not been more successful. Especially difficult from the viewpoint of traditional theory is the existence of intermittency; near the Reynolds number at which the flow snaps from laminar to turbulent short burst of turbulence spaced at random intervals are observed. Reported here are studies of the properties of dissipative coupled implicit map models, how they are related to a stochastic model of turbulence, and to the Navier-Stokes equations. Power spectra of the solutions and comparisons of the implicit map model predictions with experimental observations are included. Bifurcation diagrams, velocity profiles, and flow resistance coefficients are covered. Finally, some findings on the general shape of velocity return maps for pipe flow are discussed. DOE

N86-31014# Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro.
PROCEEDINGS OF THE 3RD BRAZILIAN SYMPOSIUM ON PIPING AND PRESSURE VESSELS
1984 799 p In ENGLISH, SPANISH and PORTUGUESE Symposium held in Salvador, Brazil, 29 Oct. 1984
(DE86-700752; INIS-BR-400; CONF-8410360) Avail: NTIS (US Sales Only) HC A99/MF A01

Papers addressing stress analysis in pipelines, heat transfer in fluid flow, deformation of materials, and fracture and failures in pressure vessels are presented. DOE

N86-31015# Tampere Univ. of Technology (Finland). Dept. of Mechanical Engineering.
EXPERIMENTS ON BINARY REFRIGERANT MIXTURES IN HEAT PUMPS [KOKEITA BINAEAERISEOKSELLA LAEMPOEPUMPUSSA]
Antero Aittomaeki and Antti Keskitalo 1984 45 p In FINNISH
(DE86-750845; TTKK-LT-39) Avail: NTIS (US Sales Only) HC A03/MF A01

Principles for utilization of binary mixtures and variable temperatures in heat pumps as well as the theory of a compressor heat pump are shortly examined in the report. A theoretical study on liquid cycle process and variable temperatures is made. The mixtures in the study, were the following refrigerants: R22/E181, R22/DMF, R12/R13, R22/R113, and H2O/NH3. The use of binary mixtures in a cold vaporization process was examined by a special test and measuring equipment. At least part of the waste heat of a compressor could be utilized in heating, but the compressor must be then cooled sufficiently. DOE

N86-31016# Sandia National Labs., Albuquerque, N. Mex.
DRAG OF BODIES OF REVOLUTION IN CAVITATING FLOW
W. L. Oberkampf and W. P. Wolfe 1986 10 p Presented at the 4th Fluid Mechanics Plasma Dynamics and Laser Conference, Atlanta, Ga., 12 May 1986 Previously announced in IAA as A86-38487

(Contract DE-AC04-76DP-00789)
(DE86-005171; SAND-85-2324C; CONF-860517-1) Avail: NTIS HC A02/MF A01

The present paper describes work in progress concerning the fluid dynamics of cavitating flow. The flow field and drag of bodies of revolution at zero angle of attack is predicted for cavity coefficients from fully-wetted flow to sigma = 0. Excellent agreement for drag coefficient is demonstrated between theory and a water tunnel experiment. It is shown that skin friction drag is the dominant drag component for zero cavity coefficient. Excellent agreement is also demonstrated between theory and a high-speed water entry experiment. This agreement corroborates the experimental measurement that the cavity pressure is equal to the water vapor pressure, contrary to low-speed water entry. DOE

N86-31017# Lawrence Livermore National Lab., Calif.
SIMULATING SOME STATISTICAL FEATURES OF DUSTY GAS TURBULENT FLOW
A. C. Buckingham 15 Nov. 1985 6 p Presented at the 4th Fluid Mechanics Plasma Dynamics and Laser Conference, Atlanta, Ga., 12 May 1986
(Contract W-7405-eng-48)
(DE86-005774; UCRL-93615; CONF-860517-2) Avail: NTIS HC A02/MF A01

Described is the application of numerical simulations as extensions of turbulent flow experiments. These computations are designed to predict the interactive influences of solid dispersants on the turbulent continuous gas phase that entrains them. Interest derives from the view that these interactions may contribute significant modulating influence to turbulent phase constituent and molecular component evolution, reactive mixing, heat, and mass transfer in solid propellant combustion. The numerical simulation procedure utilizes spectral transform projection and spectral averaging collocation methods to represent the continuous phase Navier-Stokes equations. The continuous phase is iteratively matched at discrete time intervals to a random-walk Lagrangian statistical sampling procedure for the dispersed phase momenta and position expectancies. Ensemble averaging produces statistical velocity moments for both dispersed and continuous phases. DOE

N86-31018# Los Alamos National Lab., N. Mex.
NUMERICAL EXPERIMENTS WITH CONCHAS-SPRAY: INSTALLATION OF THE FLOE ALGORITHM
Lawrence D. Cloutman Feb. 1986 35 p
(Contract W-7405-eng-36)
(DE86-007575; LA-10626-MS) Avail: NTIS HC A03/MF A01

The rezoning phase of the CONCHAS-SPRAY program models the advection terms in the Navier-Stokes equations. Consequently, this code suffers from all the numerical difficulties associated with these terms, except for pure Lagrangian calculations. In particular, the use of any of the available differencing options other than pure donor cell can create artificial oscillations in the solution through the dispersive truncation errors. This report describes the installation of a flux-limiting procedure similar to Chapman's FRAM technique that suppresses these oscillations by locally adding enough donor-cell differencing to prevent nonphysical growth of local maxima and minima. DOE

N86-31019# Los Alamos National Lab., N. Mex.
ACOUSTIC DAMPING FOR EXPLICIT CALCULATIONS OF FLUID FLOW AT LOW MACH NUMBER
J. D. Ramshaw, P. J. ORourke, and A. A. Amsden Jan. 1986 15 p
(Contract W-7405-eng-36)
(DE86-007576; LA-10641-MS) Avail: NTIS HC A02/MF A01

A method is proposed for damping the sound waves in explicit calculations of fluid flow at low Mach number, where sound waves are usually not of interest but may distract attention from other flow features. The method is based on the introduction of an artificial pressure q of the form q = - q0rhoc(2)(DELTA)t(del x u - del x u0), where q0 is a coefficient of order unity, rho is the density, c is the sound speed, (DELTA)t is the time step, and u0 is the velocity field that would obtain at zero Mach number, When del x u0 is zero, the method becomes equivalent to the use of an artificial bulk viscosity q0rhoc(2)(DELTA)t. However, del x u0 can be substantially different from zero in problems with heat or mass sources (e.g., combustion), and its inclusion is then essential to obtain the correct pressure field. The method is well suited for use in conjunction with explicit numerical schemes that employ acoustic subcycling or artificial reduction of the sound speed for improved efficiency at low Mach number. The beneficial effects of the method are illustrated by means of calculations with an acoustic subcycling computer program. DOE

N86-31020# Los Alamos National Lab., N. Mex.
INTEGRATED GRADIENTS: A DERIVATION OF SOME DIFFERENCE FORMS FOR THE EQUATION OF MOTION FOR COMPRESSIBLE FLOW IN TWO-DIMENSIONAL LAGRANGIAN HYDRODYNAMICS, USING INTEGRATION OF PRESSURES OVER SURFACES
Philip L. Browne Feb. 1986 86 p
(Contract W-7405-eng-36)
(DE86-008325; LA-10587-MS) Avail: NTIS HC A05/MF A01

This paper describes a method of deriving gradients (that is, accelerations) for difference calculations of the equations of motion (momentum conservation) in two-dimensional Lagrangian meshes in an r-z coordinate system. The method basically considers various ways of defining the masses associated with each vertex and methods of integrating pressures over the surfaces of those masses, and then combining them in various ways to conserve momentum transfer between vertices. These gradients are derived analytically for planes, cylinders, and spheres to test for uniform motion. All results described have been tested with actual numerical calculations. DOE

N86-31021# California Inst. of Tech., Pasadena.
CALTECH-DOE PROGRAM ON NUMERICAL ANALYSIS, SCIENTIFIC COMPUTING AND FUNDAMENTAL STUDIES OF MOTION, ENERGY AND MASS TRANSFER IN FLUIDS Summary Report, 1 Apr. 1983 - 31 Mar. 1986
1986 8 p
(Contracts DE-AS03-76ER-72012; DE-AM03-76SF-00767)
(DE86-008369; DOE/ER-72012/T3; SR-11) Avail: NTIS HC A02/MF A01

This report concerning the CALTECH-DOE program presents information on: vortex dynamics, turbulence and separated flows; flow in porous media and Hele-Shaw fingering; steady viscous flows with and without bifurcations; continuation methods; and boundary conditions on artificial boundaries. DOE

N86-31022# Oak Ridge National Lab., Tenn.
APPROXIMATE ANALYSIS OF THE FORMATION OF A BUOYANT SOLID SPHERE IN A SUPERCOOLED MELT
A. D. Solomon, D. G. Wilson, and V. Alexiades Mar. 1986 16 p
(Contract DE-AC05-84OR-21400)
(DE86-007882; ORNL-6212) Avail: NTIS HC A02/MF A01

A mathematical model is presented for the idealized formation and development of a buoyant sphere solidifying in an infinite pool of supercooled liquid. The solid and liquid are of the same pure material and the solid is less dense than the liquid. Initially the liquid is at a uniform temperature that is below its equilibrium freezing temperature, T/sub cr/, but above the so called hypercooled temperature, T/sub cr/ - H/c/sub L/. Here H and c/sub L/ are the latent heat of solidification and the specific heat of the liquid, respectively. An approximate solution is derived based on the Megerlin approximation method. DOE

N86-31023# Illinois Univ., Urbana. Dept. of Chemistry.
TRANSPORT AND RELAXATION PROCESSES IN SUPERCRITICAL FLUIDS Technical Progress Report, Oct. 1 - 31 Dec. 1985
J. Jonas 1985 7 p
(Contracts DE-FG22-82PC50800; DE-FG22-85PC-80503)
(DE86-008329; DOE/PC-50800/T13) Avail: NTIS HC A02/MF A01

Preparations for the study of naphthalene diffusion dissolved in the supercritical fluids carbon dioxide and ethylene have proceeded as follows. We plan to use the fixed field gradient NMR technique to monitor the diffusion of the dissolved naphthalene. However, the technique is not feasible in systems with spin-spin coupling among the nuclei of interest; unfortunately the protons on naphthalene exhibit this coupling. We thus intend to use totally deuterated naphthalene and monitor the deuterium signal, a nucleus whose coupling is negligible. We therefore have designed and built a new high pressure NMR probe for the measurement of deuterium. This probe is similar to the one used in the previous naphthalene solubility study, and accommodates the same supercritical sample cells. The probe is machined from Vespel SP-1 (a high temperature plastic), and houses a 17-1/2 turn solenoid NMR coil along with thermocouples located slightly above and below the sample area. The probe has been successfully tested to 2 kbar gas pressure. The data acquisition system for the NMR spectrometer used for supercritical fluid studies has been developed and described in this report. DOE

N86-31024# Commission of the European Communities (Luxembourg).
COMPUTER CODE CONDIF-01 (RELEASE 2) FOR TRANSIENT CONVECTIVE-CONDUCTIVE HEAT TRANSFER: USER'S MANUAL
S. Giuliani and H. Laval 1984 85 p
(DE86-780411; EUR-9448) Avail: NTIS (US Sales Only) HC A05/MF A01

CONDIF-01 is a finite element computer code developed at J.R.C. Ispra to solve natural and forced convection problems, for use in Post Accident Heat Removal studies following a hypothetical fast-reactor core meltdown. The new version of the code is capable of analyzing problems in which there exists initially a liquid (solid) region which may change phase to solid (liquid), as time proceeds. A variant of the enthalpy method is employed to model the phase change process. The presence of structures enclosing the liquid (solid) region is accounted for, but such structures are assumed to remain in the solid phase. Plane and axisymmetric situations may be analyzed. The essential characteristics of the code are outlined here. This report gives instructions for preparing input data to CONDIF-01, release 2, and describes two test problems in order to illustrate both the input and the output of the code. DOE

N86-31025# Commission of the European Communities (Luxembourg).
VOID FRACTION MEASUREMENT IN TWO-PHASE FLOW WITH X-RAYS
W. Hufschmidt and E. deClercq 1984 4 p Prepared in cooperation with Commission of the European Communities, Ispra, Italy
(DE86-780422; EUR-9487) Avail: NTIS (US Sales Only) HC A02/MF A01

The exact knowledge of the void fraction in two phase flow systems with water and vapor is of great importance for water reactors. A measurement method not disturbing the fluid flow is the absorption technique x rays. This method has been tested for the present case of small absorption lenghts (about 16mm). In collaboration with the Lehrstuhl fuer Elektronische Schaltungen of the Ruhruniversitaet, Bochum (FRG), a rapid measurement device has been developed using ionization chambers. At present steady state fluid in vertical tubes with homogeneous distribution of the two phase water vapor are tested at pressures in the range from 70 to 150 bars and rather good agreements with calculated values are found. DOE

N86-31026# Los Alamos National Lab., N. Mex.
DERIVATION OF THE EQUATIONS OF CONSERVATION OF MASS, MOMENTUM AND ENERGY OF COMPRESSIBLE FLUID MECH ANICS IN BOTH LAGRANGIAN AND EULERIAN FORMS FROM AN INTEGRAL VIEWPOINT
P. L. Browne Feb. 1986 26 p
(Contract W-7405-eng-36)
(DE86-007210; LA-10588-MS) Avail: NTIS HC A03/MF A01

This report derives, then shows the equivalence of, the Lagrangian and Eulerian equations by use of Reynolds' Transport Theorem. The differential forms of the equations are also deduced from the integral forms. Finally, some common simplifications of the equations are derived. DOE

N86-31027# Lawrence Livermore National Lab., Calif.
TIME INTEGRATION AND CONJUGATE GRADIENT METHODS FOR THE INCOMPRESSIBLE NAVIER-STOKES EQUATIONS
P. M. Gresho Jan. 1986 25 p Presented at the 6th International Conference on Finite Elements in Water, Lisbon, Portugal, 1 Jun. 1986
(Contract W-7405-eng-48)
(DE86-007177; UCRL-94000; CONF-860681-1) Avail: NTIS HC A02/MF A01

This paper addresses one class of iterative methods that are promising for cost effective Navier-Stokes simulations. The approach is based on the conjugate gradient (CG) method for solving linear algebraic systems with a symmetric positive-definite (SPD) matrix. These methods have many important characteristics: monotone convergence (in an appropriate error norm), optimal error minimization, finite termination, the direct exploitation of sparseness in the matrix, and no need to estimate iteration parameters. DOE

N86-31028# Oak Ridge National Lab., Tenn.
REMARKS ON THE CHOICE OF A STIFF ORDINARY DIFFERENTIAL EQUATION SOLVER FOR THE SOLUTION OF FLUID FLOW PROBLEMS
S. Thompson Mar. 1986 39 p
(Contract DE-AC05-84OR-21400)
(DE86-010080; ORNL-6189) Avail: NTIS HC A03/MF A01

Several aspects of the solution of fluid flow problems are discussed. A model problem is described which captures several of the salient characteristics of such problems. The model problem is derived from the one-dimensional Euler equations. It corresponds to the subcooled liquid region of a three region reactor steam generator model. The defining partial differential equations are discretized spatially using the method of pseudo-characteristics. The resulting system of ordinary differential equations is then solved by the method of lines using each of several available ordinary differential equation (ode) solvers. In addition to demonstrating that fluid flow problems can be solved effectively using adaptive mathematical software, the results also illustrate the typical performance of each solver as well as the relative merits of special solver features (eg., automatic method switching and exploitation of problem sparsity or bandedness). The model problem is also modified and used to illustrate several commonly observed characteristics of fluid flow models. The results illustrate the potential effect of solver performance of characteristics such as inaccurate water property calculations. Consequently, they explain apparent anomalies often attributed incorrectly to poor solver design and algorithmic implementation. The results also support the choice of the sparse ordinary differential solver LSODES for the solution of fluid flow problems. DOE

N86-31029# National Bureau of Standards, Gaithersburg, Md. Center for Fire Research.
CHEMICALLY REACTING TURBULENT FLOW Final Report, 1 Oct. 1982 - 30 Sep. 1985
W. M. Pitts and T. Kashiwagi Mar. 1986 43 p Sponsored by AF
(PB86-196722; NBSIR-85/3299) Avail: NTIS HC A03/MF A01 CSCL 20D

Summarized are the results of the first three years of a study on chemically reacting turbulent flow. The development of new diagnostics for variable density flows are described. These include Rayleigh light scattering for real-time, spatially-resolved concentration measurements, combined Rayleigh light scattering and hot-wire anemometry for simultaneous concentration and velocity measurements, and the development of a digital line camera which has allowed the concentration measurements to be made along a line. A study of heat transfer from heated cylinders is discussed which

has generated a much improved correlation of experimental results. These studies have also included a limited investigation of Reynolds number (Re) effects. The observed dependence of the mixing behavior on the density ratio and Re have led us to make new hypotheses concerning the nature of turbulent mixing. GRA

N86-31414*# Washington State Univ., Pullman. Dept. of Mechanical Engineering.
CONDENSATION HEAT TRANSFER UNDER A MICROGRAVITY ENVIRONMENT
L. C. Chow *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 24 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 20D

N86-31424*# New Mexico Univ., Albuquerque. Dept. of Chemical and Nuclear Engineering.
AN ANALYSIS OF ULLAGE HEAT TRANSFER IN THE ORBITAL REFUELING SYSTEM
David Kauffman *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 74 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 20D

N86-31427*# Hawaii Univ., Honolulu. Dept. of Mechanical Engineering.
MATERIALS CONSIDERATIONS IN THE DESIGN OF A METAL-HYDRIDE HEAT PUMP FOR AN ADVANCED EXTRAVEHICULAR MOBILITY UNIT
Bruce E. Liebert *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 62 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 20D

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N86-31030*# General Electric Co., Wilmington, Mass. Aircraft Instruments Dept.
HIGH ACCURACY FUEL FLOWMETER Final Report
1986 346 p
(Contract NAS3-22139)
(NASA-CR-174869; NAS 1.26:174869) Avail: NTIS HC A15/MF A01 CSCL 14B

All three flowmeter concepts (vortex, dual turbine, and angular momentum) were subjected to experimental and analytical investigation to determine the potential portotype performance. The three concepts were subjected to a comprehensive rating. Eight parameters of performance were evaluated on *a* zero-to-ten scale, weighted, and summed. The relative ratings of the vortex, dual turbine, and angular momentum flowmeters are 0.71, 1.00, and 0.95, respectively. The dual turbine flowmeter concept was selected as the primary candidate and the angular momentum flowmeter as the secondary candidate for prototype development and evaluation. B.G.

N86-31031*# Stanford Univ., Calif. Center for Space Science and Astrophysics.
SUPPORT OF THE BALLOON-BORNE ULTRAVIOLET STELLAR SPECTROGRAPH Final Report
J. G. Timothy May 1986 14 p
(Contract NASw-3935)
(NASA-CR-177152; NAS 1.26:177152) Avail: NTIS HC A02/MF A01 CSCL 14B

A (256 x 1024)-pixel imaging ultraviolet Multi-mode Microchannel Array (MAMA) detector system for flight was fabricated, evaluated, and environmentally tested for flight on the Balloon Borne Ultraviolet Stellar Spectrograph (BUSS). The goal of the program was to replace the existing SEC Vidicon with the pulse-counting MAMA detector in order to, first, improve the overall sensitivity of the BUSS telescope and spectrograph for observations of stars down to m sub v = 7 and fainter, and, second, to improve the spectral resolution and wavelength accuracy by eliminating the image drifts in the Vidicon caused by magnetic field effects. A sealed MAMA detector tube structure employing a remotely processed photocathode mounted on a window in proximity focus with the front face of the MCP was developed to avoid contamination produced by a noisy and unstable device. The configuration of the BUSS detector system in its flight ready configuration is shown. The quantum efficiency curve for the semi-transparent Cs2Te photocathode is also shown. E.R.

N86-31032# Honeywell Electro-Optics Center, Lexington, Mass.
USE OF HOLOGRAPHIC FRINGE LINEARIZATION INTERFEROMETRY (FLI) FOR DETECTION OF DEFECTS Final Report, 15 Jan. 1984 - Aug. 1985
George O. Reynolds, Donald A. Servaes, Luis Ramos, Daniel Pierce, and Ronald Mayville Nov. 1985 92 p
(Contract F49620-82-C-0001)
(AD-A166141; AFOSR-86-0108TR) Avail: NTIS HC A05/MF A01 CSCL 14/5

This final report shows that the two-exposure FLI holographic method is feasible. The two-exposure FLI technique can be utilized by increasing the linear fringe frequency. Reprints of the published papers from this contract describing the modeling/experiment program are appended. The feasibility of an automatic readout for the linear fringe method is demonstrated by showing that observable and measureable effects at the defect site can be monitored. The sensitivity analysis and results from a simple dynamic loading model are presented. A preliminary FLI experiment on composite samples with both static and thermal loading failed to find defects. Finally, recommendations of work necessary to develop the FLI technique are given. GRA

N86-31033# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
ANALYSIS OF A DOUBLY COUPLED SINGLE FIBER RESONATOR M.S. Thesis
Richard L. Glover Dec. 1985 67 p
(AD-A166851; AD-E950814; AFIT/CI/NR-86-52T) Avail: NTIS HC A04/MF A01 CSCL 17/7

An analysis of a doubly coupled single fiber resonator has been made. The addition of a second coupler to a typical single coupler resonator with less than 100 percent coupling is shown to greatly improve the finesse and sensitivity to fiber attenuation of the resonator. A simple method of achieving extremely high finesse with approximately 70 percent coupling is also shown. With typical fiber and coupler loss values from the literature included in the calculations, this device shows a minimum detectable signal on the order of 20 picometers as a microbend sensor and .17 microradians per second as a laser gyroscope. GRA

N86-31034# Sao Paulo Univ., Sao Carlos (Brazil). Inst. de Fisica e Quimica.
DEVELOPMENT OF A PULSE HEIGHT ANALYZER M.S. Thesis
E. S. Moreira 1984 119 p In PORTUGUESE
(DE86-700768; INIS-BR-387) Avail: NTIS (US Sales Only) HC A06/MF A01

The development of a Pulse Height Analyzer is described. This equipment is essential to analize data coming from detectors producing information codified in pulse amplitudes. The system developed consists of a Signal Input Module connected to a Controller Module based on a 8085A microprocessor capable of memorizing pulses up to 1 uS in 256 channels with a resolution

better than 20 mV. A Communication Module with a serial interface is used for data transfer to a host computer using RS232c protocol. The Monitoring and Operation Module consists of a hexadecimal Keybord, a 6 digit 7-segment display and a XY analog output enabling real time visualization of data on a XY monitor. The hardware and the software designed for this low cost system were optimized to obtain a typical dead time of approximately 100 uS. This device was used to acquire curves at the Small Angle X-ray Scattering Laboratory in this department. The appraratus performance was tested by comparing its data with a Northern Pulse Height Analizer model NS633 output, with favorable results. DOE

N86-31035# Massachusetts Inst. of Tech., Cambridge.
AE MONITORING INSTRUMENTATION FOR HIGH PERFORMANCE SUPERCONDUCTING DIPOLES AND QUADRUPOLES, PHASE 2 Progress Report, 1 Feb. 1985 - 31 Jan. 1986
Y. Iwasa 22 Jan. 1986 105 p
(Contract DE-AC02-83ER-40121)
(DE86-007414; DOE/ER-40121/6) Avail: NTIS HC A06/MF A01

In the past year and a half, attention has been focused on the development of instrumentation for on-line monitoring of high-performance superconducting dipoles and quadrupoles. This instrumentation has been completed and satisfactorily demonstrated on a prototype Fermi dipole. Conductor motion is the principal source of acoustic emission (AE) and the major cause of quenches in the dipole, except during the virgin run when other sources are also present. The motion events are mostly microslips. The middle of the magnet is most susceptible to quenches. This result agrees with the peak field location in the magnet. In the virgin state the top and bottom of the magnet appeared acoustically similar but diverged after training, possibly due to minute structural asymmetry, for example differences in clamping and welding strength; however, the results do not indicate any major structural defects. There is good correlation between quench current and AE starting current. The correlation is reasonable if mechanical disturbances are indeed responsible for quench. Based on AE cumulative history, the average frictional power dissipation in the whole dipole winding is estimated to be approx. 10 (MU)W cm(-3). We expect to implement the following in the next phase of this project: Application of room-temperature techniques to detecting structural defects in the dipole; application of the system to other dipoles and quadrupoles in the same series to compare their performances; and further investigation of AE starting current approx. quench current relationship. Work has begun on the room temperature measurements. Preliminary Stress Wave Factor measurements have been made on a model dipole casing. DOE

N86-30776# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
HOLOGRAPHIC INTERFEROMETRY FOR DISTORTION MEASUREMENTS OF ANTENNAS
H. U. Frey *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 149-155 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30964# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
FLOW RATE MEASURING DEVICES FOR GAS FLOWS [DURCHFLUSSMESSVERFAHREN FUER GASSTROEME]
K. W. Bonfig *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 16-42 In GERMAN (For primary document see N86-30962 22-34)
Avail NTIS HC A20/MF A01

N86-30966# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
VELOCITY PRECISION MEASUREMENTS USING LASER DOPPLER ANEMOMETRY [PRAEZISIONSMESSUNGEN VON GESCHWINDIGKEITEN MITTELS LASER-DOPPLER-ANEMOMETRIE]
D. Dopheide, G. Taux, and L. Narjes *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 52-81 In GERMAN (For primary document see N86-30962 22-34)
Avail NTIS HC A20/MF A01

N86-30968# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
ACCURACY OF HIGH PRESSURE GAS METER CALIBRATION IN THE NETHERLANDS [GENAUIGKEIT DER HOCHDRUCK-GASZAEHLEREICHUNG IN DEN NIEDERLANDEN]
P. M. A. vanderKam *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 117-144 In GERMAN (For primary document see N86-30962 22-34)
Avail NTIS HC A20/MF A01

N86-30973# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
MODERN DIFFERENTIAL PRESSURE GAS COUNTER (WIGZ) MEASUREMENT [MODERNE WIRKDRUCK-GASZAEHLERMESSUNG]
O. Brandt *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 259-300 In GERMAN (For primary document see N86-30962 22-34)
Avail: NTIS HC A20/MF A01

N86-30974# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
PRACTICAL EXPERIENCES WITH HIGH PRESSURE (HP) GAS COUNTERS. PROBLEMS OF OPERATING CALIBRATION WITH HP [PRAKTISCHE ERFAHRUNGEN MIT HOCHDRUCK-GASZAEHLERN. PROBLEME DER BETRIEBSEICHUNG MIT HOCHDRUCK]
Buresch *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 301-314 In GERMAN (For primary document see N86-30962 22-34)
Avail: NTIS HC A20/MF A01

N86-30975# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
BEHAVIOR OF TURBINE WHEEL GAS COUNTERS AT HIGH PRESSURES [VERHALTEN VON TURBINENRADGASZAEHLERN IM HOCHDRUCKBEREICH]
Dieter Schmitter *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 315-355 In GERMAN (For primary document see N86-30962 22-34)
Avail: NTIS HC A20/MF A01

N86-30979# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
EFFECTS OF PREVIOUS DISTURBANCES ON THE METER FACTORS OF A VORTEX METER [EINFLUESS VON VORSTOERUNGEN AUF ZAEHLERFAKTOREN VON WIRBELZAEHERN]
J. Boehm *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 408-428 In GERMAN (For primary document see N86-30962 22-34)
Avail: NTIS HC A20/MF A01

N86-30980# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
VORTEX GAS COUNTER TYPE WBZ 08. PRACTICAL EXPERIENCE [WIRBELGASZAEHLER TYP WBZ 08 - PRAXISERFAHRUNGEN]
Hans-Juergen Kastner *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 429-444 In GERMAN (For primary document see N86-30962 22-34)
Avail: NTIS HC A20/MF A01

N86-30981# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
THE GAS MEASURING BELL: A BASIC NORMAL EQUIPMENT FOR THE REPRESENTATION OF VOLUME UNIT FOR GASES [DIE GASMESSGLOCKE - EIN BASISNORMALGERAET ZUR DARSTELLUNG DER VOLUMENEINHEIT FUER GASE]

H. Brunnemann and A. Aschenbrenner *In its* Problems of Large Gas Flow Measurements at High and Low Pressures Jul. 1985 p 445-449 In GERMAN (For primary document see N86-30962 22-34)
Avail: NTIS HC A20/MF A01

N86-31416*# Hawaii Univ., Hilo. Dept. of Geography.
APPLICATION OF COMPUTER IMAGE ENHANCEMENT TECHNIQUES TO SHUTTLE HAND-HELD PHOTOGRAPHY
Bruce E. David *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 69 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 14E

36 LASERS AND MASERS

Includes parametric amplifiers.

N86-31036*# Old Dominion Univ., Norfolk, Va. Dept. of Geology.
THEORY AND OPERATION OF THE REAL-TIME DATA ACQUISITION SYSTEM FOR THE NASA-LaRC DIFFERENTIAL ABSORPTION LIDAR (DIAL) Final Report, 1 Jan. - 31 Dec. 1985
Carolyn Butler Jun. 1986 55 p
(Contract NCC1-28)
(NASA-CR-177151; NAS 1.26:177151; GSTR-86-4) Avail: NTIS HC A04/MF A01 CSCL 20E

The improvement of computer hardware and software of the NASA Multipurpose Differential Absorption Lidar (DIAL) system is documented. The NASA DIAL system is undergoing development and experimental deployment at NASA Langley Research Center for the remote measurement of atmospheric trace gas concentrations from ground and aircraft platforms. A viable DIAL system was developed capable of remotely measuring O3 and H2O concentrations from an aircraft platform. Test flights of the DIAL system were successfully performed onboard the NASA Goddard Flight Center Electra aircraft from 1980 to 1985. The DIAL Data Acquisition System has undergone a number of improvements over the past few years. These improvements have now been field tested. The theory behind a real time computer system as it applies to the needs of the DIAL system is discussed. This report is designed to be used as an operational manual for the DIAL DAS. E.R.

N86-31037*# Colorado Univ., Boulder. Dept. of Chemistry.
DESIGN AND CHEMICAL SYNTHESIS OF IODINE-CONTAINING MOLECULES FOR APPLICATION TO SOLAR-PUMPED I* LASERS Semiannual Progress Report, 1 Jan. - 30 Jun. 1986
Christopher S. Shiner 1986 4 p
(Grant NAG1-437)
(NASA-CR-176854; NAS 1.26:176854) Avail: NTIS HC A02/MF A01 CSCL 20E

The design and chemical synthesis of new media for solar pumped iodine molecule lasers are explored. In an effort to prepare an iodo fluorocarbon compound absorbing strongly at 300 nm or above, the synthesis of perfluoro allylic iodides was investigated. These compounds furnish especially stable allylic radicals upon photodissociation. The desired red shift is anticipated in the absorption maximum could correlate with increasing radical stability. This expectation was based upon the analysis, previously reported, of the structures and absorption maxima of compounds studied earlier. A previously unknown substance was prepared, a prototypical target molecule, perfluoro-3-iodocyclopent-1-ene. It was obtained by reaction of perfluorocyclopentene with sulfur trioxide under the influence of antimony pentafluoride catalyst, followed by treatment of the resulting allylic fluorosulfonate with sodium iodide in sulfoland solvent. Preliminary data indicate that the absorption maximum for the iodo fluorocarbon is not shifted significantly to longer wavelength. It is not certain whether this result reflects an unexpected influence of the cyclic structure upon the position of the absorption maximum. E.R.

N86-31038# State Univ. of New York, Buffalo. Dept. of Chemistry.
TRANSIENT EXCITATION OF ANHARMONIC ADSPECIES BY PULSED LASER RADIATION Interim Report
J. T. Lin, Xi-Yi Huang, and Thomas F. George Apr. 1986 10 p (Contract N00014-86-K-0043)
(AD-A166308; UBUFFALO/DC/86/TR-6) Avail: NTIS HC A02/MF A01 CSCL 20/5

The excitation of anharmonic adspecies by pulsed laser radiation is investigated theoretically in the transient regimes. New features include the optimum values of pulse duration and detuning and the oscillatory behavior of the time dependent excitation caused by the anharmonicity. GRA

N86-31039# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHINESE JOURNAL OF LASERS, THE TENTH YEAR (1974-1984)(SELECTED ARTICLES)
Zhang Meizhen, Li Chengfu, Zhou Yongzong, Fan Relying, and Lu Yuemei 11 Apr. 1986 26 p Transl. into ENGLISH from Zhong Guo Jiguang (China), v. 11, no. 11, 1984 p 665-666; 686-690
(AD-A166747; FTD-ID(RS)T-0006-86) Avail: NTIS HC A03/MF A01 CSCL 20/5

Lasing Characteristics of High Quality Nd:YAG Crystals Grown by Temperature Gradient Technique are discussed. A Nd:YAG crystal of 05x50 mm in size was grown by a temperature gradient technique. It has good optical homogeneity (interference fringe number is zero) and an efficiency of 1% at 1 or 2 pps. It is easy to be operated in TEM sub 00 mode. Antireflective Coating has high efficiency at 1.06 micrometers. The error of the two-layer antireflective coating is analysed. It is shown that optical properties of the film composed of non-quarter wavelength stack are more stable that those of the film composed of quarter wavelength stack. The two-layer antireflective film has been made on K9 substrate and Ta2O5 and SiO2 used as coating material. Its reflectivity at one surface is lower than 0.03% and laser induced damage threshold is over 7 GW/cc (at 1.06 micrometer and 1 ns). GRA

N86-31040# Illinois Univ., Chicago. Dept. of Physics.
COHERENT EXTREME ULTRAVIOLET GENERATION AND SURFACE STUDIES USING ULTRAVIOLET EXCIMER LASERS Final Report, 15 Jul. 1984 - 31 Jan. 1985
Charles K. Rhodes 10 Feb. 1986 129 p
(Grant AF-AFOSR-0365-83)
(AD-A167087; AFOSR-86-0168TR) Avail: NTIS HC A07/MF A01 CSCL 20/5

The goal of this research program is the development of coherent X-ray sources is the kilovolt range. An initial application of short wavelength radiation in the vacuum ultraviolet region for photoemission studies of GaHz surfaces has been performed demonstrating the feasibility of this class of experiments. A basic and long-standing problem in the field of coherent sources is that associated with the generation of coherent energy in the extreme ultraviolet and soft x-ray regions. During the last three years, picosecond rare gas halogen (RGH) excimert laser technology, on account of the very favorable scaling relationships governing the spectral brightness of these sources, has emerged as a key factor in new techniques useful for generation of coherent radiation below 100 nm. The operation of RGH systems will be extended down into the femtosecond region, a development that will enable sources with peak powers P in the 1TW < or = 10TW range to be used in physical studies. Light sources of this kind should permit the generation of focal intensities above approx 10 to the 20th power S/c c. GRA

N86-31041# Naval Research Lab., Washington, D. C.
ARGON PUFF GAS SOFT X-RAY LASER
J. Davis, J. P. Apruzese, C. Agritellis, and P. Kepple 25 Apr.

1986 42 p
(AD-A167127; NRL-MR-5771) Avail: NTIS HC A03/MF A01 CSCL 20/5

A non-LTE dynamic argon pinch model has been applied to investigate the feasibility of creating conditions favorable to gain coefficients in excess of unity during the implosion of a cylindrical annular argon gas puff plasma. Preliminary results obtained from the SIMPLODE model suggest that it is possible to achieve measureable gain in the 3p-3s lasing transition at 434 A in neonlike argon. GRA

N86-31042# Department of the Air Force, Washington, D.C.
TRIPLE CAVITY LASER Patent Application
L. Smith, inventor (to Air Force) Filed 4 Mar. 1986 21 p
(AD-D012292; US-Patent-Appl-SN-836043) Avail: NTIS HC A02/MF A01 CSCL 20/5

The invention comprises a semiconductor laser having an attached etalon which imposes two additional reflective cavity resonance conditions on a laser diode. The etalon has partially reflective front surface and an inner surface which act in conjunction with the internal cavity of the laser diode to reduce side mode emission from the laser. This results in laser emission of a single dominant mode, i.e., a single discrete wavelength of coherent light, from the surface. GRA

N86-31043# Lawrence Livermore National Lab., Calif.
OPTIMIZED FLASHLAMP PUMPING OF DISC AMPLIFIERS
J. E. Murray, H. T. Powell, and B. W. Woods 17 Jan. 1986 56 p Presented at the Los Angeles Symposium and Exhibition on Optical and Electro-optical Engineering, Los Angeles, Calif., 19 Jan. 1986
(Contract W-7405-eng-48)
(DE86-007121; UCRL-93321; CONF-860117-6) Avail: NTIS HC A04/MF A01

Disk amplifier design for inertial fusion lasers has evolved with changing fusion-driver requirements from a primary emphasis on gain to a primary emphasis on efficiency. In this paper we compare Shiva and Nova amplifiers to a developmental amplifier (SSA) and show greater than a two-fold improvement in efficiency over past designs under all operating conditions. Experiments to optimize the efficiency of the SSA show that preionization of the flashlamps produces significant benefits and that the packing fraction of lamps is more important than the flashlamp reflector shape. They also show that the optimized flashlamp pulselength and reflector geometry depend on the desired stored energy in the laser medium. We have demonstrated a 7% storage efficiency at a stored fluence per disk of 0.5 J/cm(2) (stored energy density of 0.06 J/cm(3)) and 4% at 2.0 J/cm(2) (0.25 J/cm(3)). Comparison of SSA measurements with storage-efficiency calculations show that our flashlamp model accurately predicts the single-pass pumping of disk amplifiers. DOE

N86-31044# Rochester Univ., N. Y. Lab. for Laser Energetics.
LABORATORY FOR LASER ENERGETICS Annual Report, 10 Oct. 1984 - 30 Sep. 1985
Jan. 1986 232 p
(Contract DE-FC08-85DP-40200)
(DE86-006834; DOE/DP-40200/05) Avail: NTIS HC A11/MF A01

Overviews of the GDL and OMEGA facilities are given. The retrofit of the GDL with liquid crystal polarizers is described. Synchronization of the actively mode-locked and actively Q-switched oscillators is described. Progress in laser fusion includes a theory of electron heat transport, sputter-coating of laser targets, absorption line measurement of the tamper, x-ray conversion for high-Z targets, mass ablation in uv-irradiated targets, uv target designs, stimulated Raman scattering in a collisional homogeneous plasma, and absorption spectroscopy as a diagnostic. DOE

N86-31045# Los Alamos National Lab., N. Mex.
INVESTIGATION OF OPTICAL DAMAGE VIA RESONANCE IONIZATION MASS SPECTROMETRY
R. C. Estler and N. S. Nogar 1985 7 p Presented at the 17th Annual Symposium on Optical Materials for High-Power Lasers, Boulder, Colo., 28 Oct. 1985
(Contract W-7405-eng-36)
(DE86-007369; LA-UR-86-769; CONF-851052-4) Avail: NTIS HC A02/MF A01

Resonance ionization mass spectrometry (RIMS) has been used as a diagnostic for interrogating optical damage events. RIMS involves multistep laser photoionization, generally through real intermediate states, followed by mass separation and detection. It is a sensitive and selective means of detection, and has the potential for detection of ultratrace inclusions in substrates and/or coatings. In initial experiments, damage on uncoated CaF2 substrates was initiated by pulses of 1.06-(MU)m light from a Q-switched ND(+3):YAG laser. Interrogation of the spalled plume revealed CaF radicals only when damage events occurred. No Ca atoms were observed, and no attempt was made to detect F atoms or CaF2. In subsequent experiments conducted at laser intensities below the damage threshold, we observed the presence of surface adsorbents and a correlation between the presence of the adsorbents and the occurrence of optical damage. DOE

N86-31046# Lawrence Livermore National Lab., Calif.
FREE-ELECTRON LASERS FOR STRATEGIC DEFENSE: THE BENEFITS OF SCIENTIFIC OPEN SCIENTIFIC EXCHANGE
W. A. Barletta 24 Feb. 1986 8 p Presented at the International Seminar on Nuclear War, Erice, Italy, 19 Aug. 1985
(Contract W-7405-eng-48)
(DE86-008033; UCRL-94166; CONF-8508154-3) Avail: NTIS HC A02/MF A01

A dominant theme of the Fifth International Seminar on Nuclear War, held at Erice, Sicily, (August 19-24, 1985), was the appeal for openness in science and in technological research. In his address to the seminar, Italian Foreign Minister Giulio Andreotti cited the remarkable achievements at the European Center for Nuclear Research (CERN), as an inspiring example of the benefits of scientific collaboration across national borders - science without frontiers. Dr. Edward Teller eloquently argued that, thanks to a nearly complete lack of official secrecy, computer technology has flourished in the free societies of the United States, Japan, and Western Europe. The superiority of this technology, vis-a-vis its status in the Soviet bloc, has enhanced both the national security and the economic vitality of the United States and its allies. A further example of the success of science without secrecy can be found in another technology of major importance to the goals of America's Strategic Defense Initiative (SDI). The technology of note is the free electron laser (FEL). DOE

N86-31047# Oak Ridge National Lab., Tenn. Computing and Telecommunications Div.
MATHEMATICAL MODELING OF LASER INDUCED ULTRA-RAPID MELTING AND SOLIDIFICATION
V. Alexiades, J. B. Drake, G. A. Geist, G. E. Giles, A. D. Solomon, and R. F. Wood Mar. 1986 52 p
(Contract DE-AC05-84OR-21400)
(DE86-008482; ORNL-6129) Avail: NTIS HC A04/MF A01

Mathematical and numerical aspects of laser induced phase change modeling are discussed. Several numerical formulations, including explicit and implicit enthalpy, adaptive grid finite volume and front tracking are derived and results are presented. In addition, a novel hyperbolic formulation is explored analytically and numerically. The explicit enthalpy approach allows the greatest flexibility and efficiency in modeling problems with complicated phase transitions. The LASER8 program is described. DOE

N86-31048# Los Alamos National Lab., N. Mex.
NARROW BAND TUNING WITH SMALL LONG PULSE EXCIMER LASERS
R. C. Sze, N. Kurnit, D. Watkins, and I. Bigio Dec. 1985 19 p Presented at the 8th International Conference on Lasers, Las Vegas, Nev., 2 Dec. 1985
(Contract W-7405-eng-36)
(DE86-007368; LA-UR-86-770; CONF-851208-3) Avail: NTIS HC A02/MF A01

We discuss frequency narrowing and tuning with simple dispersion elements with small long-pulse excimer lasers. The improved performance over short-pulse lasers is discussed and attributed to the increased number of round trips. A physical model of the dynamics of line narrowing is presented. DOE

N86-31049# Lawrence Livermore National Lab., Calif.
BETATRON MOTION AND OPTICAL DEFLECTION IN FREE ELECTRON LASERS
T. J. Karr Oct. 1985 49 p
(Contract W-7405-eng-48)
(DE86-009556; UCRL-53718) Avail: NTIS HC A03/MF A01

Transverse displacement of the electron beam at input to the wiggler induces betatron oscillation, imparting a sinusoidal transverse displacement to the gain medium seen by the optical beam. As the light propagates down this rippled medium it is guided by the dispersion, thereby acquiring some transverse sinusoidal displacement. At output from the wiggler the optical beam in general has acquired some transverse component of velocity, that is, it propagates off-axis. As the e-beam displacement fluctuates statistically with every pulse, the optical output direction jitters around the nominal axis. The jitters is estimated with a model that includes off-axis optical propagation through a rippled gain medium but neglects feedback of the off-axis light on the e-beam. The model is solved in perturbation theory. The jitter is calculated at the final aperture of the optical system beyond the wiggler. DOE

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N86-31050 Bundesanstalt fuer Materialpruefung, Berlin (West Germany).
TRIBOLOGY DOCUMENTATION: WEAR, FRICTION, AND LUBRICATION
H. Tischer, E. Rudolph, and D. Mercks 1985 1179 p In ENGLISH and GERMAN
(BAM-GFT-19-1983/84; ISSN-0340-3475; ESA-86-97477) Copyright. Avail: Issuing Activity

Six thousand references covering all aspects of tribology, including experimental methods and equipment; friction and wear laws, mechanisms, and effects; appearance of damage; wear and friction under specific stressing conditions; materials and combinations of materials; surface coatings; operating conditions; environment influences; lubrication; applications of tribology in technical design and processes; and basic information on solid surfaces and contacts are listed. ESA

N86-31051# Southwest Research Inst., San Antonio, Tex. Belvoir Fuels and Lubricants Research Facility.
FUEL COMPONENT AND HETEROATOM EFFECTS ON DEPOSITS AND WEAR Interim Report, 1 Oct. 1981 - 30 Sep. 1984
E. A. Frame Dec. 1985 50 p
(Contracts DAAK70-85-C-0007; DAAK70-82-C-0001)
(AD-A166839; AD-E950814; BFLRF-190) Avail: NTIS HC A03/MF A01 CSCL 21/4

The objective of this project was to investigate the effects of fuel heteroatom compounds on diesel engine performance, particularly engine deposition and wear. This work involved operating a single-cylinder diesel research engine using a highly controlled base fuel (JP-7) which was extremely low in sulfur and nitrogen. The engine lubricant was a synthetic polyalphaolefin material, also free of sulfur and nitrogen. Thus, wear and deposit effects observed during the 60-hour single-cylinder laboratory engine test were directly related to the heteroatom compound added to the base fuel. Through these controlled laboratory engine tests, wear and deposit effects were studied using four different types of known fuel sulfur complexes, and two different fuels containing naturally occurring sulfur compounds. Fuel sulfur type did not appear to directly influence wear rate, whereas the disulfide-type sulfur was found to produce high piston deposit tendencies. No increase in engine wear was observed for three fuels each of which contain a different known nitrogen compound. Fuel injector deposits and fouling occurred with some of the nitrogen-containing fuels. A fuel containing a combination of both known sulfur and nitrogen hetero-atoms was tested and no synergistic effects on wear or deposits were observed. GRA

N86-31052# Department of the Air Force, Washington, D.C.
LOW TEMPERATURE RATE CONTROLLER Patent
Arthur Holmberg, Jr. and Earl M. Altman, inventors (to Air Force) Issued 25 Feb. 1986 4 p Supersedes AD-D011029
(AD-D012277; US-Patent-4,572,488; US-Patent-Appl-SN-559612; US-Patent-Class-267-8R) Avail: NTIS Avail: US Patent and Trademark Office CSCL 22/2

This invention relates generally to shock absorbers, and, more particularly, to shock absorbers that are used in outer space applications. The present invention uses a pair of flexible metal bellows sealed to a piston and a housing by continous welds. A gas occupies sealed volumes external to the bellows on either side of the piston and is metered through a resistive channel to that volume on the opposite side of the piston. A center volume between these volumes is open to the external environment. This center volume, is a typical shock absorber, internal to the two bellows is filled with a damping fluid. An actuator rod is attached to the piston and one end is attached to a load while the other end is attached to a stable platform. A spring that is used to drive the load in a given direction is attached to the rod and motion thereof is damped by the rate controller. One object of the present invention is to provide in outer space. Another object of the present invention is to provide a rate controller that is hermetically sealed. GRA

N86-31053# Army Engineer Topographic Labs., Fort Belvoir, Va.
GEOGRAPHIC INFORMATION SYSTEMS IN ROBOTIC VEHICLES
Bruce B. Zimmerman, Richard L. Rosenthal, and Jerry M. Breen 1986 13 p
(AD-A166859; ETL-R-083) Avail: NTIS HC A02/MF A01 CSCL 13/6

Robotic vehicles offer potential to the Army for force multiplication and removing the soldier from hazardous environments. The Army robotic vehicle program will provide a supervised autonomy capability with full battlefield mobility. To accomplish this the control system will require a person in the control loop at least part of the time. The Army program incorporates several technologies including a digital terrain data base, product generation capabilities, stereo vision, and an inertial position and attitude unit. These technologies allow for vehicle operation over-the-hill and beyond line-of-sight. This paper will discuss the detailed use of terrain data and terrain data products, such as route planning and three-dimensional synthetic scenes, in the interactive control of a robotic vehicle. Of particular importance is the relation of the terrain data to the vision data and position and attitude data. This paper will also discuss the similarities and difference between GIS requirements for interactive robotic vehicle control and autonomous vehicles, such as in the DARPA Autonomous Land Vehicle Program. Author (GRA)

N86-31054# Department of the Navy, Washington, D. C.
DOUBLE-STAGE AIR FILTER Patent Application
W. D. Craig, inventor (to Navy) Filed 10 Feb. 1986 20 p
(AD-D012307; US-Patent-Appl-SN-827589) Avail: NTIS HC A02/MF A01 CSCL 13/11

This patent application discloses an improved double-stage air filter of modular construction for attachment between aligned openings of a spaced double wall structure to supply filtered air flow to a controlled area. The filter is generally made up of casing means and combined plate means and sleeve means. Both the casing means and plate are provided with a flange means. The sleeve means is provided with a series of perforations and the plate means flange means is provided with a plurality of relatively

spaced slots. The casing means flange means is affixed to the outer wall so that the casing means extends between the walls. The plate means includes retainer means that is affixed to the inner wall so that the sleeve means is inserted in the casing means. Inner and outer filter means for cleaning and purifying an air flow are disposed about the sleeve means. Retainer means are connected to the casing means flange means so as to hold the filter means in sealing engagement between the last mentioned retainer means and the plate means. During filter use, an airflow to be filtered is directed through the sleeve perforations, the filter means, and the slots of the plate flange means thereby supplying filtered air to the controlled area. GRA

N86-31055# Sanders (Nicholas A.), Norwich, Vt.
ENGINE HEATING DEVICE Final Report
N. A. Sanders 1986 83 p
(Contract DE-FG01-82CE-15141)
(DE86-005095; DOE/CE-15141/T1) Avail: NTIS HC A05/MF A01

The engine heating device development project was supported by DOE grant No. DE-FG01-82CE15141. The engine heating device recovers waste engine exhaust heat and stores it for later use in rewarming the cold engine prior to starting. Heat is stored in the phase change and sensible heat capacity of a storage material. This device finds application in the cold weather starting of gasoline and diesel engines. During the grant period three major technical issues were addressed: (1) design optimization; (2) quantifying device performance, and (3) field testing. Two totally different designs were looked at during design optimization, i.e., a horizontally mounted unit and a vertically mounted unit. The latter, with its up and down concentric flow pattern, proved to be the best design. This is because of its superior heat storage ability and its simpler design. A number of different heat storage materials were looked at during this stage of the program. The material selected best for this application was Lithium Nitrate (LiNO3). A problem of low heat transfer rates from the heat storage material was solved by the insertion of wire mesh into the storage material. DOE

N86-31056# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
TRITIUM GAS TRANSFER PUMP DEVELOPMENT
C. L. Sharpe 1985 14 p Presented at the 46th DAMSUL Committee Meeting, O ak Ridge, Tenn., 5 Jun. 1985
(Contract DE-AC09-76SR-00001)
(DE86-007164; DP-MS-85-108; CONF-8506255-1) Avail: NTIS HC A02/MF A01

Non-lubricated, hermetically sealed pumps for tritium service have been selected to replace Sprengel pumps in the existing Tritium Facility. These pumps will be the primary gas-transfer pumps in the planned Replacement Tritium Facility. The selected pumps are Metal Bellows Corporation's bellows pumps and Normetex scroll pumps. Pumping range for a Normetex/Metal Bellows system is from 0.01 torr suction to 2300 torr discharge. Performance characteristics of both pumps are presented. DOE

N86-31057# Sandia National Labs., Livermore, Calif. Joining Model Labs. Div.
PREDICTION OF ELECTRON BEAM WELDING DEPTH OF PENETRATION
W. H. Giedt Feb. 1986 26 p
(Contract DE-AC04-76DR-00789)
(DE86-007837; SAND-86-8205) Avail: NTIS HC A03/MF A01

Analytical and experimental results showing the relationship between electron beam welder settings and penetration depth were reviewed. This led to the development an equation for representing the relation between partial penetration and the independent variables involved in electron beam welding. Beam focus current deviation was found to have the greatest influence on predicted penetration. The priority for precision in machine settings was concluded to be: (1) optimum beam focus current; (2) beam voltage or current; (3) travel speed; and (4) focus coil to work distance. M.G.

N86-31058# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
ZIRCONIA TO CAST IRON BRAZING FOR UNCOOLED DIESEL ENGINES
M. L. Santella, J. P. Hammond, S. A. David, and W. A. Simpson 1985 8 p Presented at the 21st Automotive Technology Development Contractors' Coordination Meeting, Dearborn, Mich., 14-17 Nov. 1983
(Contract DE-AC05-84OR-21400)
(DE86-008982; CONF-8510103-7) Avail: NTIS HC A02/MF A01

Partially stabilized zirconia has been successfully brazed to nodular cast iron by the active substrate process. The process involves coating the ceramic with an agent that promotes wetting and allows the use of commercially available ductile brazing alloys. Process details and the microstructure of zirconia-cast iron joints are described. A method of testing the shear strength of braze interfaces is outlined, and data for zirconia interfaces tested at 25 and 400(0)C are presented. Joints between zirconia and cast iron or titanium develop shear strengths typically in excess of 130 MPa at 25(0)C, but strength at 400(0)C is lower. The reduced strength is related to porosity in the braze joints, and a means of eliminating this porosity is discussed. Preliminary observations indicate that aging at 400(0)C produces no major microstructural changes in the braze joints. Also, the brazing of 115-mm-diameter discs of zirconia and cast iron, and the nondestructive examination of these brazements, is discussed. DOE

N86-31059# California Univ., Santa Barbara.
DUTY CYCLE TESTING AND PERFORMANCE EVALUATION OF THE SM-229 TELEOPERATOR
R. S. Stoughton and D. P. Kuban Nov. 1985 28 p Presented at the 20th Aerospace Mechanism Symposiu, Cleveland, Ohio, 7 May 1986 Prepared in cooperation with Oak Ridge National Lab., Tenn.
(Contract DE-AC05-84OR-21400)
(DE86-004780; CONF-860560-1) Avail: NTIS HC A03/MF A01

This paper contains the first known experimental studies and analyses of teleoperator performance for specific duty cycles. The results are presented in two distinct areas as position usage patterns, and as three-dimensional power grids. The position usage patterns are a valuable means to assess the available motion range. The power grids are a unique concept for evaluating joint performance. Final conclusions contain recommendations to upgrade the teleoperator for optimum performance. DOE

N86-31060# Technical Research Centre of Finland, Espoo.
OIL HYDRAULICS IN ARCTIC REGIONS
H. Vainio, M. Lehmusto, and S. Mikkonen Dec. 1984 37 p In FINNISH
(DE86-751569; VTT-TIED-395) Avail: NTIS (US Sales Only) HC A03/MF A01

Oil hydraulics in arctic conditions has been studied. Seals, oils and hydraulic motors were tested down to the temperature -50 deg C. Some seals operated satisfactory at the temperature -50 deg C when lightly loaded. Because of good viscosity properties the hydraulic oils used for aeroplanes are well suited for use in cold environments. High speed low torque-hydraulic motors operated satisfactory in cold environment. A hydraulic system of a cargo hatch in an arctic vessel was tested in a cold room. The effects of large differences in temperature must be taken into account when planning hydraulic systems. DOE

N86-31061# Allied Bendix Corp., Kansas City, Mo.
ROBOT-ASSISTED TORQUE MEASUREMENT
J. R. Lembke Mar. 1986 27 p
(Contract DE-AC04-76DP-00613)
(DE86-009129; BDX-613-3478) Avail: NTIS HC A03/MF A01

An Intelledex 605T robot was used to evaluate the feasibility of automating the measurement of rotary solenoid torque, with the goal of improving productivity. The solenoid chosen for the evaluation is expected to be produced in relatively large quantities for several programs. A new measurement concept was devised, in which the robot connects the solenoid shaft to a torque sensor,

rotates the solenoid housing, and correlates rotational data with digitized torque measurements. Prototype tooling was designed and fabricated, and the measurement concept was evaluated in comparison with the manual method which is presently used. The automatic robot-based measurement system was shown to yield results that are in good agreement with manual measurements. The technique automatically performs all necessary operations once the solenoids have been placed into a part loading fixture, with a cycle time significantly reduced from the manual method. Manual interpretation of chart data is not required, because the results are digitized. The system can compare the measured torque to specification limits and can provide a printed report of acceptance or rejection. its and can provide a printed report of acceptance or rejection. DOE

N86-31062# Sandia National Labs., Albuquerque, N. Mex.
CALORIMETRY OF PULSED VERSUS CONTINUOUS GAS TUNGSTEN ARC WELDS
G. A. Knorovsky and P. W. Fuerschbach 1986 19 p Presented at the ASM International Trends in Welding Research Meeting, Gatlinburg, Tenn., 18 May 1986
(Contract DE-AC04-76DP-00789)
(DE86-009285; SAND-86-0818C; CONF-860594-1) Avail: NTIS HC A02/MF A01

A technique to measure heat input to welds is used in conjunction with metallography to compare the heat inputs, penetrations, volumes melted, and arc and melting efficiencies of pulsed versus conventional Gas Tungsten Arc autogenous standing edge welds in thin gauge 304L stainless steel. These results are a necessary link between computer models and real weld machine settings. Results show that machine output and heat input correlate better with RMS values of current than with average values. Arc efficiency increased slightly and melting efficiency increased dramatically for increased travel speed at nominally constant heat inputs. Also, for two conditions of average current and travel speed corresponding to similar nominal heat inputs, one an efficient combination (81 amps at 12.2 mm/s) the other an inefficient combination (42 amps at 6.3 mm/s), current pulsing increased penetration only for the inefficient case. Comparing the processes on the basis of penetration divided by heat input, the continuous weld made under efficient conditions was best. However, some nonreproducible pulsed welds gave an exceptionally high value for this parameter. It is believed that resonance between the liquid pool motion and the pulse frequency may explain this phenomenon. DOE

N86-31063# Battelle Columbus Labs., Ohio.
GAS-ENGINE HEAT PUMP TEST PROCEDURES Topical Report, Oct. 1985 - Feb. 1986
S. G. Talbert and A. L. Rutz Apr. 1986 67 p
(Contract GRI-5084-242-1118)
(PB86-201662; GRI-86/0083) Avail: NTIS HC A04/MF A01 CSCL 13A

The purpose is to establish standardized procedures for testing gas engine-driven heat pumps,and to define the various engine heat pump performance factors. The recommended test methods outlined should enable Gas Research Institute to better monitor the several research projects now underway to develop gas engine heat pumps for residential and light commercial use. Altogether, 17 performance test points are described which will be sufficient to describe the heating and cooling performance of a variable speed heat pump over its expected range of outdoor temperatures. The tests include 11 steady-state tests, two part-load tests one defrost test, one auxiliary heater test, and two domestic water heating tests. Equations and procedures also are outlined so that the various heat pump performance factors can be calculated, as well as its expected seasonal and annual performance. GRA

N86-31064# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
DESIGN OF BOLTED JOINTS IN COMPOSITES
1985 27 p Presented at the 60th Meeting of the Structures and Materials Panel of AGARD, San Antonio, Tex., 21-26 Apr. 1985
(AGARD-R-727; ISBN92-835-1531-5) Avail: NTIS HC A03/MF A01

This publication contains three papers heard by the Structures and Materials Panel Sub-Committee on Mechanically Fastened Joints in Composites. The papers survey the various parameters governing the behaviour of bolted joints, and give some experimental data representative of behaviour under load. It is concluded that poor static strength, rather than good fatigue strength, is a characteristic of this type of joint; a Panel Specialists Meeting is to review the topic. Author

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N86-31065*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DETERMINATION OF GRAIN SIZE DISTRIBUTION FUNCTION USING TWO-DIMENSIONAL FOURIER TRANSFORMS OF TONE PULSE ENCODED IMAGES
Edward R. Generazio Jun. 1986 24 p
(NASA-TM-88790; E-3125; NAS 1.15:88790) Avail: NTIS HC A02/MF A01 CSCL 11F

Microstructural images may be tone pulse encoded and subsequently Fourier transformed to determine the two-dimensional density of frequency components. A theory is developed relating the density of frequency components to the density of length components. The density of length components corresponds directly to the actual grain size distribution function from which the mean grain shape, size, and orientation can be obtained. Author

N86-31066# Oak Ridge Y-12 Plant, Tenn.
ACOUSTIC EMISSION TRANSIENT RECORDING
S. A. Wallace, E. W. Walker, J. W. Whittaker, and J. R. Younkin Nov. 1985 32 p
(Contract DE-AC05-84OS-21400)
(DE86-006908; Y/DW-612) Avail: NTIS HC A03/MF A01

Laser welds of less than eight seconds duration are routinely performed at the Oak Ridge Y-12 Plant. The primary material welded is stainless steel sheet of thickness 0.25 mm or less. Cracking and porosity formation in the weld are a significant concern. Due to the difficulty of ultrasonically observing cracks in the small weld beads, an investigation is underway to evaluate the acoustic emission technique as an in-process means of identifying crack formation. The recording system being used is described and a signature algorithm is included for locating acoustic activity at a one millisecond resolution. DOE

N86-31067# Allied Bendix Corp., Kansas City, Mo.
IMPROVED MAGNETIC PARTICLE INSPECTION OF SMALL THREADED FASTENERS
J. A. Brunk Mar. 1986 21 p
(Contract DE-AC04-76DP-00613)
(DE86-009324; BDX-613-3283) Avail: NTIS HC A02/MF A01

Magnetic particle inspection is required for over 100 types of threaded fasteners used at Bendix Kansas City Division of Allied Corporation. Most are purchased screws and bolts made to AN, MS, and NAS specifications. These specifications invariably require that testing be in accordance with MIL-I-6868E, Inspection Process, Magnetic Particle. This specification includes directions for magnetization of test objects that are inappropriate for many small parts, particularly for screws and bolts of less than about 8-mm thread diameter. Following those directions is more likely to interfere with the detection of serious defects than to ensure that they will be found. Alternate testing techniques that make it easier to find and correctly interpret defect indications have been developed. A new semiautomatic magnetic particle testing machine for threaded fasteners and other small parts up to 9.5 mm in

diameter and 150 mm in length is being built to BKC specifications, with delivery scheduled for April, 1985. Interim procedures using existing equipment have been adopted to improve the reliability of magnetic particle inspection of small fasteners. DOE

N86-30784# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
NONDESTRUCTIVE TESTING OF FIBER REINFORCED COMPOSITES USING X-RAY FINE STRUCTURE PROCEDURES
J. Walter and Henschel (Bundesanstalt fuer Materialpruefung, Berlin, West Germany) *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 217-229 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30785# Fulmer Research Inst. Ltd., Stoke Poges (England).
DEVELOPMENTS IN THE NONDESTRUCTIVE EVALUATION (NDE) OF COMPOSITE MATERIALS
R. L. Crocker *In its* Proceedings of a Workshop on Composites Design for Space Applications (ESA-SP-243) Feb. 1986 p 231-235 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N86-31068# British Library Lending Div., Boston Spa (England).
EXPERIMENTAL AND ANALYTICAL RESULTS OF LARGE-SCALE PRESSURIZED THERMAL SHOCK TESTING
A. Sauter, H. Huber, and T. Nguyen-Huy 1986 33 p Transl. into ENGLISH from "Experimentelle und Analytische Ergebnisse eines Grossversuchs zur Notkuehlsimulation" Stuttgart, West Germany 33 p Presented at the 11th MPA Seminar, Stuttgart, West Germany, 10-11 Oct. 1985
(BLL-Risley-TR-5282-(9091.9F)) Avail: British Library Lending Div., Boston Spa, England

The systems engineering activity concentrated on evaluation of emission model characteristics and the requirements they impose on the Orbit Transfer Vehicles (OTV), establishing debris/meteoroid shielding criteria, and updating Mission and Systems Requirements document. The Macintosh based computer system was expanded to encompass performance calculations coupled with the mission model. Two configuraton updates were indicated for the baseline vechicles: the ground based vehicle will have debris/meteoroid shielding added to the propellant tanks; the space based vehicle will be resized to accommodate the new driving manned GEO sortie mission (probably to the vicinity of 75,000 pounds propellant load). The optimum cargo bay appears to be tending towards the shortest possible configuration, the torous LOX tank version. The definition of the aeroassist trade vehicles is progressing, but conclusions are not yet available. The trajectory control evaluations were conducted for all 14 STS upper atmosphere profiles, and the guidance algorithm performs accurately in all cases. B.G.

N86-31069*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SENSTITIVTY ANALYSIS AND OPTIMIZATION OF NODAL POINT PLACEMENT FOR VIBRATION REDUCTION
Jocelyn I. Pritchard, Howard M. Adelman, and Raphael T. Haftka (Virginia Polytechnic Inst. and State Univ., Blacksburg.) Jul. 1986 34 p
(NASA-TM-87763; NAS 1.15:87763) Avail: NTIS HC A03/MF A01 CSCL 20K

A method is developed for sensitivity analysis and optimization of nodal point locations in connection with vibration reduction. A straightforward derivation of the expression for the derivative of nodal locations is given, and the role of the derivative in assessing design trends is demonstrated. An optimization process is developed which uses added lumped masses on the structure as design variables to move the node to a preselected location - for example, where low response amplitude is required or to a point which makes the mode shape nearly orthogonal to the force distribution, thereby minimizing the generalized force. The optimization formulation leads to values for added masses that adjust a nodal location while minimizing the total amount of added mass required to do so. As an example, the node of the second mode of a cantilever box beam is relocated to coincide with the centroid of a prescribed force distribution, thereby reducing the generalized force substantially without adding excessive mass. A comparison with an optimization formulation that directly minimizes the generalized force indicates that nodal placement gives essentially a minimum generalized force when the node is appropriately placed. Author

N86-31070*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AEROELASTIC CONSIDERATIONS FOR TORSIONALLY SOFT ROTORS
Wayne R. Mantay and William T. Yeager, Jr. Aug. 1986 20 p Presented at the AHS 2nd Decennial Specialists' Meeting on Rotorcraft Dynamics, Moffett Field, Calif., 7-9 Nov. 1984
(NASA-TM-87687; NAS 1.15:87687; USAAVSCOM-TR-86-B-1) Avail: NTIS HC A02/MF A01 CSCL 20K

A research study was initiated to systematically determine the impact of selected blade tip geometric parameters on conformable rotor performance and loads characteristics. The model articulated rotors included baseline and torsionally soft blades with interchangeable tips. Seven blade tip designs were evaluated on the baseline rotor and six tip designs were tested on the torsionally soft blades. The designs incorporated a systemmatic variation in geometric parameters including sweep, taper, and anhedral. The rotors were evaluated in the NASA Langley Transonic Dynamics Tunnel at several advance ratios, lift and propulsive force values, and tip Mach numbers. A track sensitivity study was also conducted at several advance ratios for both rotors. Based on the test results, tip parameter variations generated significant rotor performance and loads differences for both baseline and torsionally soft blades. Azimuthal variation of elastic twist generated by variations in the tip parameters strongly correlated with rotor performance and loads, but the magnitude of advancing blade elastic twist did not. In addition, fixed system vibratory loads and rotor track for potential conformable rotor candidates appears very sensitive to parametric rotor changes. Author

N86-31071*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STRESS ANALYSIS OF THE CRACKED LAP SHEAR SPECIMENS: AN ASTM ROUND ROBIN
W. S. Johnson Aug. 1986 87 p
(NASA-TM-89006; NAS 1.15:89006) Avail: NTIS HC A05/MF A01 CSCL 20K

This ASTM Round Robin was conducted to evaluate the state of the art in stress analysis of adhesively bonded joint specimens. Specifically, the participants were asked to calculate the strain-energy-release rate for two different geometry cracked lap shear (CLS) specimens at four different debond lengths. The various analytical techniques consisted of 2- and 3-dimensional finite element analysis, beam theory, plate theory, and a combination of beam theory and finite element analysis. The results were examined in terms of the total strain-energy-release rate and the mode I to mode II ratio as a function of debond length for each specimen geometry. These results basically clustered into two groups: geometric linear or geometric nonlinear analysis. The geometric nonlinear analysis is required to properly analyze the CLS specimens. The 3-D finite element analysis gave indications of edge closure plus some mode III loading. Each participant described his analytical technique and results. Nine laboratories participated. Author

N86-31072# Minnesota Univ., Minneapolis. Dept. of Aerospace Engineering and Mechanics.
STRUCTURAL INELASTICITY 28: A FINITE ELEMENT VECTORIZATION METHOD FOR THE SOLUTION OF CRACK GROWTH PROBLEMS IN 2 OR 3 DIMENSIONS Final Report
Philip G. Hodge, Jr. Feb. 1986 34 p
(Contract N00014-82-K-0020)
(AD-A166545; AEM-H2-4) Avail: NTIS HC A03/MF A01 CSCL 20/11

A summary and bibliography are presented of the investigations of structural inelasticity. Research conducted under this contract included two distinct projects. The first was concerned with using simple truss models to illustrate certain critical aspects of nonlinear material behavior. The other project was concerned with using a constant-strain finite element method to find complete solutions for the stress and displacement in a plate with a centered crack. The elastic solution was obtained first. The elastic/plastic solution was completed after the expiration of this contract. GRA

N86-31073# California Univ., Berkeley. Dept. of Civil Engineering.
AN AUGMENTED ALAGRANGIAN FORMULATION FOR THE FINITE ELEMENT SOLUTION OF CONTACT PROBLEMS Interim Report, Jan. - Dec. 1985
Joseph A. Landers and Robert L. Taylor Mar. 1986 42 p
(Contract N62583-85-M-R079; YR0-2303)
(AD-A166649; NCEL-CR-86.008) Avail: NTIS HC A03/MF A01 CSCL 13/13

A solution method for small deformation frictionless contact problems is developed. First, a review of various solution methods for contact problems is given. Next, a detailed discussion is made of the augmented Lagrangian method. Then, the finite element implementation is discussed. Finally, sample problems and their solutions are presented to demonstrate the usefulness of the method. Both the static and dynamic solution algorithms are described in this report. Author (GRA)

N86-31074# Brown Univ., Providence, R. I. Div. of Engineering.
USE OF THE SHADOW SPOT METHOD IN EVALUATING J FOR DUCTILE STEELS
A. Marchand, L. B. Freund, C. C. Ma, and J. Duffy Feb. 1986 50 p
(Contract N00014-85-K-0597)
(AD-A166834; ONR-0597/1) Avail: NTIS HC A03/MF A01 CSCL 20/11

Caustic curve patterns obtained by the shadow spot method have been used in the past to give direct optical measurement of the elastic stress intensity factor in nominally brittle material. An advantage of the optical shadow spot method is that it provides a direct measure of the intensity of the crack tip stress field. The method is based on the idea that the value of the stress intensity factor can be related to features of the optical field obtained by transmitting parallel light through the crack tip region of a transparent specimen or by reflecting light from the surface of an opaque specimen. Most structural materials that contain cracks undergo substantial plastic deformation under rising load prior to onset of crack growth. Recently, the range of applicability of the shadow spot method was extended to the elastic-plastic power hardening materials. It was noted that the value of Rice's J-integral can be viewed as a plastic strain intensity factor. Methods for measuring values of J for ductile fracture specimens are available but the methods are indirect, in the sense that values of J are inferred from other measured quantities, typically load-deflection data. The shadow spots obtained in the test should be formed by reflection of light arrays from points well within the crack tip plastic zone where the one parameter plastic intensity singular field is dominant. The method of caustics provides a measurement which is customarily interpreted on the basis of plane stress. GRA

N86-31075# Brown Univ., Providence, R. I. Div. of Engineering.
THE STRESS INTENSITY FACTOR HISTORY DUE TO THREE DIMENSIONAL TRANSIENT LOADING OF THE FACES OF A CRACK
L. B. Freund Feb. 1986 28 p
(Contract N00014-85-K-0597; Grant NSF MSM-85-13096)
(AD-A166835) Avail: NTIS HC A03/MF A01 CSCL 20/11

A procedure is described for determining dynamic stress intensity factor histories for a half plane crack in an otherwise unbounded elastic body, with the crack faces subjected to tractions that result in variation of the stress intensity factor along the crack edge. The procedure is based on integral transform methods and the properties of analytic functions of a complex variable. The procedure is illustrated for the case of a pair of opposed line loads suddenly applied on the crack faces along a line perpendicular to the crack edge. An exact expression is obtained for the resulting mode I stress intensity factor as a function of time for any point along the crack edge. Some features of the solution, as well as possible extensions of the procedure, are discussed. Author (GRA)

N86-31076# Army Armament Research and Development Command, Watervliet, N. Y. Close Combat Armaments Center.
A DESIGN METHOD FOR AUTOFRETTAGED THICK-WALLED CYLINDERS WITH OUTSIDE DIAMETER DISCONTINUITIES Final Technical Report
J. J. Busuttil, Jr. and J. A. Kapp Feb. 1986 29 p
(AD-A166881; AD-E440321; ARCCB-TR-86009) Avail: NTIS HC A03/MF A01 CSCL 20/11

A design method has been developed to determine the fatigue life of thickwalled autofrettaged cylinders containing outside diameter (OD) notches which act as failure initiation sites. The method uses local strain analysis for fatigue crack initiation and fracture mechanics analysis for crack propagation to failure. The method is relatively easy to program and thus can be used to optimize cylinder designs with respect to OD initiated failures. The computer program developed requires only minimal input to estimate life: cylinder dimensions, notch depth and root radius, internal pressure, and material yield strength. Other material properties (low cycle fatigue data, fracture toughness, and crack growth law) and permanently stored. The program calculates the elastic stress concentration factor using a Neuber diagram as a default. If the elastic kt is known from other sources, this feature of the program can be overridden. The stress concentration factor is used to calculate notch root stresses from which local strains are estimated. Once the local strains are known, crack initiation life is estimated using the stored low cycle fatigue data. A crack is then assumed to exist and a power law is integrated to determine crack propagation life to failure. The total life is the sum of the initiation and propagation lives. The applicability of the design method is demonstrated by using it to predict the total fatigue lives of existing cylinder designs with measured fatigue lives. GRA

N86-31077# Maryland Univ., College Park. Dept. of Aerospace Engineering.
A NEW EFFICIENT APPROACH TO THE FORMULATION OF MIXED FINITE ELEMENT MODELS FOR STRUCTURAL ANALYSIS Interim Report, May - Jun. 1986
S. W. Lee and J. J. Rhiu Feb. 1986 32 p
(Contract N00014-84-K-0385)
(AD-A167340) Avail: NTIS HC A03/MF A01 CSCL 20/11

A new finite element formulation is developed based on the Hellinger-Reissner principle with independent strain. By dividing the assumed strain into the lower order part and the higher order part, the new formulation can be made much more efficient than the standard mixed formulation. In addition the present new approach provides a rational way of introducing stabilization matrix to suppress undesirable kinematic modes. Author (GRA)

N86-31078# Sandia National Labs., Albuquerque, N. Mex.
DYNAMIC RESPONSE OF RANDOM PARAMETERED STRUCTURES WITH RANDOM EXCITATION
L. J. Branstetter and T. L. Paez Feb. 1986 161 p
(Contract DE-AC04-76DP-00789)
(DE86-007246; SAND-85-1175) Avail: NTIS HC A08/MF A01

A Taylor series expansion technique is used for numerical evaluation of the statistical response moments of a linear

multidegree of freedom (MDF) system having random stiffness characteristics, when excited by either stationary or nonstationary random load components. Equations are developed for the cases of white noise loading and single step memory loading, and a method is presented to extend the solution to multistep memory loading. The equations are greatly simplified by the assumption that all random quantities are normally distributed. A computer program is developed to calculate the response moments of example systems. A program user's manual and listing (DYNAMO) are included. Future extensions of the work and potential applications are discussed. DOE

N86-31079# Sandia National Labs., Albuquerque, N. Mex.
DYNAMIC RESPONSE MOMENTS OF RANDOM PARAMETERED STRUCTURES WITH RANDOM EXCITATION
L. J. Branstetter and T. L. Paez 1986 8 p Presented at the 3rd ASCE Engineer Mechanics Specialty Conference on Dynamic Response of Structures, Los Angeles, Calif., 31 Mar. 1986
(Contract DE-AC04-76DP-00789)
(DE86-004567; SAND-85-1887C; CONF-860371-1) Avail: NTIS HC A02/MF A01

First and second order statistical response are formulated for linear multi-degree of freedom dynamical systems having both random load and random structural characteristics. A matrix, ordinary differential equation describing system response is discretized in time, integrated, and then rewritten in the form of a Taylor series expansion of each random element about its mean value. This equation is then used to form response moment expression. Evaluation of the moments is made possible by the development of useful recursive formulas. Results are verified with analytic solutions. The method is usefui for the analysis of static or dynamic random response. DOE

N86-31080# Argonne National Lab., Ill.
TWO-SURFACE PLASTIC MODEL FOR CONCRETE AND GEO-MATERIALS
J. C. Chern, F. B. Lin, and A. H. Marchertas 1986 7 p Presented at the International Conference on Computational Mechanics, Tokyo, Japan, 25 May 1986 Prepared in cooperation with National Taiwan Univ., Taipei and Northwestern Univ., Evanston, Ill.
(Contract W-31-109-eng-38)
(DE86-007475; CONF-860585-1) Avail: NTIS HC A02/MF A01

A constitutive model based on the elastic-plastic formulation coupled with the critical state theory used in soils is presented. A conventional elastic-plastic model is applied to represent the structural behavior up to the maximum strength capacity of material. Beyond this point, the modified critical state theory is used to simulate the material response. In this way, the softening (or hardening) of the material can be accounted for. The softening (or hardening) of the material is facilitated by the shrinkage (or expansion) of a limiting surface in the stress space. This surface is assumed to coincide with the failure surface at the maximum strength of material. It is derived with the help of the five-parameter Willam-Warnke failure surface. The shape of the limiting surface has the same angular dependence as the failure surface of the deviatoric plane. In the meridian plane, the shape is assumed to be that of a slanted ellipse. The described constitutive model is very simple, requiring a minimum of experimental data for input. It is applicable to concrete, geomaterials, and other materials which have different strengths in tension and compression. DOE

N86-31081# Los Alamos National Lab., N. Mex.
FLEXURE STRENGTH ANALYSIS OF LOS ALAMOS CERAMIC BODIES Al-13, Al-18, AND MgO-Y2O3
Jack H. Enloe, Frank G. Gac, and Eralio J. Trujillo Feb. 1986 29 p
(Contract W-7405-eng-36)
(DE86-008576; LA-10617-MS) Avail: NTIS HC A03/MF A01

Flexure strength was determined by four-point loading and analyzed using Weibull analysis for selected Los Alamos National Laboratory ceramic materials including an MgO-3 wt % Y2O3 body and alumina bodies AL-13 and AL-18. Fractographic and microstructural characterizations were also performed on the materials. Results of the Weibull analysis conclude that AL-13 has exceptionally high strength reliability, whereas AL-18 and MgO-3 wt% Y2O3 have strength reliabilities comparable to most ceramic materials. Strength data were also compared to data for similar materials from commercial literature. DOE

N86-31082# Knolls Atomic Power Lab., Schenectady, N. Y.
EFFECTIVE TEARING MODULUS: A MODEL FOR BRITTLE FRACTURE AND TEARING INSTABILITY
B. D. Macdonald Mar. 1986 38 p
(Contract DE-AC12-76SN-00052)
(DE86-008785; KAPL-4190) Avail: NTIS HC A03/MF A01

The objective of this study was to determine a model for the transition regime and upper shelf fracture resistance of low-strength/high-toughness structural steels. The success of the model was measured in two ways: (1) the condition for fracture specimen maximum load, intersection of applied and material effective tearing modulus curves, was satisfied for compact tension data in the transition and upper shelf fracture regimes; (2) maximum load attained by surface-flawed intermediate test vessels (ITV's) was accurately calculated by using the model and associated compact tension data. The fracture model attribute of stress-dependent plastic zone constraint was thought to be primarily responsible for its thickness insensitivity. Metallurgical fracture mode insensitivity of the model in the transition regime was thought to be primarily due to the use of a plastic zone addition to the physical crack size. Calculation of the fracture model parameters (crack driving/resistance forces and their derivatives with respect to the plastic-zone-corrected crack) was enhanced by the availability of and relationship to linear elastic fracture mechanics formulas. Ligament size criteria consistent with the fracture model were determined empirically for the compact tension specimen. Pressure vessel analyses indicated that model accuracy was acceptable provided that the average hoop stress was less than the yield stress. DOE

N86-31083# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
THE PROSPECTS FOR FINITE ELEMENT ANALYSIS METHODS FOR STRUCTURAL QUALIFICATION
Apr. 1986 15 p Presented at the 61st Meeting of the Structures and Materials Panel of AGARD, Oberammergau, West Germany, 8-13 Sep. 1985
(AGARD-R-736; ISBN92-835-1526-9) Avail: NTIS HC A02/MF A01

As part of its 61st Meeting the AGARD Structures and Materials Panel considered whether or not it should set up an activity to examine the possibilities of Structural Qualification by using Finite Element Analytical Methods in place of testing. As a preliminary to its discussions it heard the two papers printed here. The first of these looks in general terms at the capabilities of existing organisations and systems vis- a-vis the standards which must necessarily be established before FEM qualification procedures can be implemented. The second paper looks in rather more detail at how non-linear FEM may be applied in support of structural tests. Author

N86-30641# Israel Aircraft Industries Ltd., Ben-Gurion Airport.
STATIC AEROELASTIC ANALYSIS USING AIRCRAFT VIBRATION MODES
Z. Sheena and M. Karpel *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 229-232 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30646# Pilatus Aircraft Ltd., Stans (Switzerland).
EXPERIENCE WITH AEROELASTIC ANALYSIS OF A SINGLE ENGINE TURBO TRAINER USING FINITE ELEMENT METHODS
M. J. Reinicke, A. S. Turi (Omega G.m.b.H., Immenstaad West Germany), and A. Vollan *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 286-296 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30666# RESSULT, Soechtenau (West Germany).
ANALYTICAL FINITE ELEMENTS
Peter H. Kulla *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 495-503 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30667# Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
INFLUENCE OF AXIAL FORCE ON RANDOM VIBRATION RESPONSE OF A STRUCTURE
Isaac Elishakoff *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 504-511 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30668# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
DETERMINATION OF BOTH COMPLEX CHARACTERISTIC STRUCTURAL VALUES AND NORMAL MODE PARAMETERS FROM HARMONIC EXCITATION NEAR RESONANCE
J. Artmann *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 512-522 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30669# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. of Aeroelasticity.
ADVANCES IN GROUND VIBRATION TESTING USING A COMBINATION OF PHASE RESONANCE AND PHASE SEPARATION METHODS
N. Niedbal *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 523-528 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30670# Franche-Comte Univ., Besancon (France). Lab. de Mecanique Appliquee.
SIMULTANEOUS DETERMINATION OF NORMAL EIGENMODES AND GENERALIZED DAMPING MATRIX FROM COMPLEX EIGENMODES
Qiang Zhang and Gerard Lallement *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 529-535 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30671# Kassel Univ. (West Germany).
IDENTIFICATION AND DYNAMIC CONDENSATION OF PHYSICAL SYSTEM MATRICES USING INCOMPLETE DYNAMIC RESPONSE DATA
M. Link and K. Badenhausen *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 536-545 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30673# London Univ. (England). Dept. of Aeronautical Engineering.
DETERMINATION OF FORCE DISTRIBUTIONS IN MULTI-POINT RESONANCE TESTING USING VARIOUS DIRECT METHODS
K. Alexiou and J. R. Wright *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 553-564 Sponsored by UK Ministry of Defence (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30674# Franche-Comte Univ., Besancon (France). Lab. de Mecanique Appliquee.
EIGENSOLUTION IDENTIFICATION OF NON SELF-ADJOINT MECHANICAL STRUCTURES
Qiang Zhang and Lallement Gerard *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 565-570 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30675# Manchester Univ. (England). Simon Engineering Labs.
RECENT DEVELOPMENTS IN THE IDENTIFICATION OF NON-LINEARITY IN MODAL TESTING
G. R. Tomlinson *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 571-580 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30676# Old Dominion Coll., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
ADVANCES IN TIME DOMAIN MODAL IDENTIFICATION AND MODELING OF STRUCTURES
Samir R. Ibrahim *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 581-594 Sponsored by AFWAL (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30677# London Univ. (England). Queen Mary Coll.
COMPARISON OF SOME TIME DOMAIN METHODS FOR STRUCTURAL SYSTEM IDENTIFICATION
J. E. Cooper and J. R. Wright *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 595-604 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30681# Technische Univ., Hanover (West Germany).
UPDATING MATHEMATICAL MODELS ON THE BASIS OF VIBRATION AND MODAL TEST RESULTS, A REVIEW OF EXPERIENCE
H. G. Natke and N. Cottin *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 625-631 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

N86-30762# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THERMAL RESIDUAL STRESSES IN SYMMETRIC AND UNSYMMETRIC CARBON FIBER REINFORCED PLASTICS: SOME TENTATIVE WAYS OF EVALUATION
J. P. Favre *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 31-38 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30764# Southampton Univ. (England). Inst. of Sound and Vibration Damping.
DAMPING OF COMPOSITES
T. A. Willway *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 47-52 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30765# Imperial Coll. of Science and Technology, London (England). Center for Composite Materials.
THE STRENGTH OF BOLTED JOINTS IN KEVLAR RP
J. M. Hodgkinson, D. L. deBeer, and F. L. Matthews *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 53-61 Sponsored by ESA (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30768# Politecnico di Milano (Italy). Dept. of Aerospace Engineering.
ANALYTICAL AND EXPERIMENTAL RESULTS OF ADVANCED COMPOSITE STIFFENED PANELS UNDER COMBINED LOADS
Giulio Romeo *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 79-86 Sponsored by Italian Ministry of Education (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30769# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost.

HAND CALCULATION METHOD FOR BUCKLING OF COMPOSITE SHELL STRUCTURES
R. F. P. vanZelst *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 87-93 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30770# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Space Div.
ADEQUATE FIBER REINFORCED STRUCTURAL ELEMENTS IN LOAD INTRODUCTION AREA OF FIBER REINFORCED SHELLS
F. S. D. Rekers *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 95-99 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30778# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Aeronautical Structures and Materials.
DAMAGE ZONE FRACTURE ANALYSIS OF FIBROUS COMPOSITES
Kaj Hollmann, Per Clarin, C.-G. Aronsson, and Jan. Baecklund *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 169-174 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30779# Engineering System International, Rungis (France).
INDUSTRIAL CALCULATION OF DAMAGE TOLERANCE AND STRESS ALLOWABLES IN COMPONENTS MADE OF COMPOSITE MATERIALS USING THE PAM-FISS/BIPHASE MATERIAL MODEL
A. deRouvray and E. Haug *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 175-185 Sponsored by ESA/ESTEC (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30780# Paderborn Univ. (West Germany). Fachgebeit Technische Mechanik.
ON CORRELATION BETWEEN THERMAL STRESSES, ELASTIC STRAIN ENERGY AND DEBONDING IN THERMALLY LOADED FIBER-REINFORCED COMPOSITE MATERIALS
F.-G. Buchholz *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 187-196 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30781# Strathclyde Univ., Glasgow (Scotland). Dept. of Mechanics of Materials.
ASSESSING THE EFFECTS OF DELAMINATIONS ON THE POSTBUCKLING STRENGTH OF CRFP PANELS
W. M. Banks, J. Rhodes, and G. B. Chai *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 197-202 Sponsored by UK Ministry of Defense and ESA (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

42 GEOSCIENCES (GENERAL)

N86-31084# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Hochfrequenztechnik.
THE X-SAR SCIENCE PLAN
Herwig Oettl and Francesco Valdoni (Consiglio Nazionale delle Ricerche, Rome, Italy) Nov. 1985 165 p
(DFVLR-Mitt-85-17; ISSN-0176-7739; ESA-86-97451) Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

Use of the X-SAR/SIR-C radar for geology, hydrology, oceanography, ice and snow cover, and vegetation remote sensing are discussed. For individual titles, see N86-31085 through N86-31092. ESA

N86-31085# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
THE X-SAR SCIENCE TEAM **c32**
H. Oettl *In its* The X-SAR Science Plan Nov. 1985 p 7-10 (For primary document see N86-31084 22-42)
Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

The SIR-C X-band SAR mission for remote sensing of weather, oceans, ice, vegetation, pollution, and geological features is introduced. Mission objectives include comparison of different polarizations and investigations of frequencies for SAR applications. ESA

N86-31086# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
PRINCIPLE OF SAR AND X-SAR PERFORMANCE. THE X-SAR/SIR-C MISSION. SOME REMARKS CONCERNING ORGANIZATION ASPECTS **c32**
H. Oettl *In its* The X-SAR Science Plan Nov. 1985 p 11-26 (For primary document see N86-31084 22-42)
Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

The principles of SAR are recalled and its technical limitations are reviewed. Specifications of the SIR-C mission for X-band remote sensing are given: 9.6 GHz frequency; VV polarization; 25 m geometrical resolution; 10 to 45 km swath width; viewing angle 15 to 60 deg; and radiometric resolution of 2.5 dB at sigma = -18 dB. Project organization is described. ESA

N86-31087# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
RADAR TECHNOLOGY **c32**
F. Heel and D. Solimini *In its* The X-SAR Science Plan Nov. 1985 p 27-41 (For primary document see N86-31084 22-42)
Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

Atmospheric and ionospheric effects on SAR signal performance in the frequency range of the S-SAR/SIR-C mission are reviewed. Mission accompanying ground truth activities and calibration facilities are discussed. Processor capability to achieve improved SAR image quality is assessed. ESA

N86-31088# Technische Univ., Clausthal-Zellerfeld (West Germany). Inst. fuer Geologie und Palaeontologie.
GEOLOGY **c46**
P. Kronberg and P. Murino (Naples Univ., Italy) *In* DFVLR The X-SAR Science Plan Nov. 1985 p 43-74 (For primary document see N86-31084 22-42)
Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

Experiments to study how spaceborne imaging radar can improve geological mapping capability and capacity are proposed for the X-SAR/SIR-C mission. Complementary data X-SAR-type imagery can provide at regional to global scales as compared to information from Landsat sensors is discussed. Expected information on rocks, soils, and structures is assessed. Effect of radar operating parameters (illumination geometry, frequency, and polarization) on radar backscatter of rock units and surficial deposits in diverse type of terrain (arid, semi-arid, Mediterranean, humid, tropical areas; plains, rolling country, hilly and mountainous terrain) is considered. Test areas to evaluate the application potential of multifrequency, multipolarization, and multi-incidence-angle imagery for regional and global geological mapping projects are suggested. ESA

N86-31089# Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (West Germany).
HYDROLOGY **c43**
W. Kruck and P. Pampaloni (Consiglio Nazionale delle Ricerche, Florence, Italy) *In* DFVLR The X-SAR Science Plan Nov. 1985 p 75-95 (For primary document see N86-31084 22-42)
Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

Hydrological parameters that can be studied by spaceborne imaging radar are listed. Test sites for X-SAR/SIR-C mission remote

sensing of precipitation and surface runoff; ground water, evaporation, and evapotranspiration; and soil moisture, and surface and radar penetration parameters are proposed. ESA

N86-31090# Bremen Univ., (West Germany).
OCEANOGRAPHY **c48**
W. Alpers, K. Richter (Deutsches Hydrographisches Inst., Hamburg (West Germany), and P. Lombardini (Consiglio Nazionale delle Ricerche, Turin, Italy) *In* DFVLR The X-SAR Science Plan Nov. 1985 p 97-110 (For primary document see N86-31084 22-42)
Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

Radar imaging of ocean surface phenomena at three different radar frequencies (L, C, and X-band) different polarizations (VV, HH and VH, HV) and different incidence angles by the X-SAR radar is discussed. Objectives of the X-SAR/SIR-C mission include studies of the short wave-current interaction as a function of (Bragg) wave number; the SAR imaging mechanism of long surface waves as a function of radar frequency, polarization, and incidence angle; the excitation threshold of short (Bragg) waves by the wind as a function of wave number and air/sea temperature difference; the damping of short (Bragg) waves by surface films as a function of a wave number, and film material for studying the applicability of spaceborne SARs for oil pollution surveillance; and the distribution of temporal variations of internal waves, eddies, fronts, and bores in the Mediterranean. ESA

N86-31091# Deutsches Hydrographisches Inst., Hamburg (West Germany).
ICE AND SNOW **c43**
Klaus Struebing *In* DFVLR The X-SAR Science Plan Nov. 1985 p 111-131 (For primary document see N86-31084 22-42)
Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

Ice and snow observation by the X-SAR/SIR-C mission is outlined. Targets include sea ice and icebergs, ice sheets, ice shelves, glaciers, and snow cover. Parameters to be studied include snow line; edges and boundaries; ice concentration (total and partial); stage of development (ice type, thickness); form (floe size); openings (fractures, leads, polynyas); surface roughness (ridges, rubble fields, rafted ice); and stage of melting (puddles, melt ponds). Test sites, seasonal constraints, technical requirements, and ground truth and airborne campaigns are indicated. ESA

N86-31092# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
VEGETATION **c43**
A. J. Sieber, F. Posa (Bari Univ., Italy), and M. Ricottilli (Consiglio Nazionale delle Ricerche, Rome, Italy) *In its* The X-SAR Science Plan Nov. 1985 p 133-155 (For primary document see N86-31084 22-42)
Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

Economic and technical advantages of X-SAR/SIR-C remote sensing of vegetation and land use are discussed. Investigations for the X-SAR mission are summarized: Radar response as function of biophysical properties of crops; crop type identification; phenological evaluation; vegetation stress conditions; vegetation indexes; rangeland assessment; and synergic effects of combining optical and SAR data for identifying and characterizing crop cover. ESA

N86-31093*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEOPOTENTIAL RESEARCH MISSION, SCIENCE, ENGINEERING AND PROGRAM SUMMARY
Thomas Keating, ed., Patrick Taylor, ed., Werner Kahn, ed., and Francis Lerch, ed. Jul. 1986 209 p
(NASA-TM-86240; Rept-86B0409; NAS 1.15:86240) Avail: NTIS HC A10/MF A01 CSCL 08E

This report is based upon the accumulated scientific and engineering studies pertaining to the Geopotential Research Mission (GRM). The scientific need and justification for the measurement of the Earth's gravity and magnetic fields are discussed. Emphasis is placed upon the studies and conclusions of scientific organizations and NASA advisory groups. The engineering design and investigations performed over the last 4 years are described, and a spacecraft design capable of fulfilling all scientific objectives is presented. In addition, critical features of the scientific requirements and state-of-the-art limitations of spacecraft design, mission flight performance, and data processing are discussed. Author

N86-31094*# National Aeronautics and Space Administration, Washington, D.C.
EARTH OBSERVING SYSTEM. DATA AND INFORMATION SYSTEM. VOLUME 2A: REPORT OF THE EOS DATA PANEL
1986 63 p
(NASA-TM-87777; NAS 1.15:87777) Avail: NTIS HC A04/MF A01 CSCL 05B

The purpose of this report is to provide NASA with a rationale and recommendations for planning, implementing, and operating an Earth Observing System data and information system that can evolve to meet the Earth Observing System's needs in the 1990s. The Earth Observing System (Eos), defined by the Eos Science and Mission Requirements Working Group, consists of a suite of instruments in low Earth orbit acquiring measurements of the Earth's atmosphere, surface, and interior; an information system to support scientific research; and a vigorous program of scientific research, stressing study of global-scale processes that shape and influence the Earth as a system. The Eos data and information system is conceived as a complete research information system that would transcend the traditional mission data system, and include additional capabilties such as maintaining long-term, time-series data bases and providing access by Eos researchers to relevant non-Eos data. The Working Group recommends that the Eos data and information system be initiated now, with existing data, and that the system evolve into one that can meet the intensive research and data needs that will exist when Eos spacecraft are returning data in the 1990s. Author

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N86-31095# Defense Mapping Agency Hydrographic and Topographic Center, Washington, D.C.
A COMPARISON OF ADOS (AFRICAN DOPPLER SURVEY) POINT POSITIONING RESULTS FROM VARIOUS SOFTWARES Final Report
Thomas J. Knopp 27 Feb. 1986 16 p Presented at the International Geodetic Symposium on Satellite Positioning, Austin, Tex., 28 Apr. - 2 May 1986
(AD-A166840; AD-E950814) Avail: NTIS HC A02/MF A01 CSCL 08/5

The African Doppler Survey project (ADOS) is a multi-national effort to establish primary control (via Doppler satellite observations) on the African continent. There are four Computing Centers under the ADOS project which use three different point positioning programs. These programs are: DOPL79, GEODOP V, and ORB-SPP. The differences observed in the computations using the various softwares were recently investigated. This paper presents preliminary results of this study. GRA

N86-31096# Argonne National Lab., Ill.
DISTRIBUTED GEOGRAPHIC MAPPING USING A CENTRALIZED DISSPLA-BASED MAPPING SYSTEM AND AUTOCAD PC SOFTWARE
M. Snider 1986 7 p Presented at the ISSCO Week, New Orleans, La., 10 Mar. 1986
(Contract W-31-109-eng-38)
(DE86-009184; CONF-860363-2) Avail: NTIS HC A02/MF A01

This paper describes procedures devised for transferring mapped information between a DISSPLA-based geographic

mapping system on a centralized computer and an AUTOCAD system on a PC. The centralized mapping system is used as a repository for the large map data bases and to provide capabilities for drawing maps on various output devices including graphics terminals. The map data from any map drawn on the centralized system can be down-loaded to the PC. AUTOCAD is then used to view and edit the map and to add information. Final maps can be drawn using the AUTOCAD software or the AUTOCAD files can be sent to the centralized system to be included in the central data bases. These procedures allow us to take advantage of DISSPLA software, data management facilities, and graphical analytic functions available on the central system, while using the more interactive features available in AUTOCAD for viewing, entering, and editing the data. DOE

N86-31097# Royal Netherlands Aircraft Factories Fokker, Amsterdam.
PHASE A TECHNICAL STUDY SUMMARY REPORT FOR A TROPICAL EARTH RESOURCES SATELLITE (TERS)
1984 116 p Prepared in cooperation with National Aerospace Lab., Amsterdam, Netherlands, Signaal, Utrecht State Univ., Netherlands, and Technische Physische Dienst TNO-TH, Delft, Netherlands
(JTERS-84-07; ESA-86-97496) Avail: NTIS HC A06/MF A01

The high (1681 km) equatorial orbit of the Tropical Earth Resources Satellite with its particle radiation hazards (as compared to an alternative low near equatorial orbit with operational complications) was studied. Selective viewing by cloud sensor and cross track instrument pointing was analyzed. The consequences of the high spectral resolution (20 m color, 10 m panchromatic) for the designs of instrument, satellite systems, data handling, and ground data processing were assessed. Ground observations at different solar illumination angles and view angles were simulated. A satellite configuration concept was defined. The concept seems feasible, although it is technologically challenging. Radiation aspects require a careful development and may influence the design of instrument and spacecraft systems. ESA

N86-31098# Royal Netherlands Aircraft Factories Fokker, Amsterdam.
PROPOSAL TO NIVR FOR A SYSTEM DEFINITION STUDY OF A TROPICAL EARTH RESOURCES SATELLITE (TERS)
1984 158 p Prepared in cooperation with National Aerospace Lab., Amsterdam, Netherlands, Signaal, Utrecht State Univ., Netherlands, and Technische Physische Dienst TNO-TH, Delft, Netherlands
(NTERS-84-11; ESA-86-97497) Avail: NTIS HC A08/MF A01

A study to provide a technical definition of the Tropical Earth Resources Satellite (TERS) spacecraft, ground station, data preprocessing facilities and satellite operations in sufficient detail for a reliable estimate of the required budget and time for the realization of a TERS project is proposed. It should also provide a better insight into the feasibility aspects of such a project. The technical definition includes system and subsystem design specifications, and definition of the products to be supplied to the users. The execution of the project is defined up to and including the in-orbit checkout. ESA

N86-31089# Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (West Germany).
HYDROLOGY
W. Kruck and P. Pampaloni (Consiglio Nazionale delle Ricerche, Florence, Italy) *In* DFVLR The X-SAR Science Plan Nov. 1985 p 75-95 (For primary document see N86-31084 22-42)
Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

N86-31091# Deutsches Hydrographisches Inst., Hamburg (West Germany).
ICE AND SNOW
Klaus Struebing *In* DFVLR The X-SAR Science Plan Nov. 1985 p 111-131 (For primary document see N86-31084 22-42)
Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

N86-31092# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
VEGETATION
A. J. Sieber, F. Posa (Bari Univ., Italy), and M. Ricottilli (Consiglio Nazionale delle Ricerche, Rome, Italy) *In its* The X-SAR Science Plan Nov. 1985 p 133-155 (For primary document see N86-31084 22-42)
Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N86-31099*# Old Dominion Univ., Norfolk, Va. Dept. of Mathematical Sciences.
SUMMARY OF MATHEMATICAL MODELS FOR A CONVENTIONAL AND VERTICAL JUNCTION PHOTOCONVERTER Progress Report, 1 Mar. - 30 Jun. 1986
John H. Heinbockel Jun. 1986 104 p
(Grant NAG1-148)
(NASA-CR-177144; NAS 1.26:177144) Avail: NTIS HC A06/MF A01 CSCL 10A

The geometry and computer programming for mathematical models of a one-dimensional conventional photoconverter, a one-dimensional vertical junction photoconverter, a three-dimensional conventinal photoconverter, and a three-dimensional vertical junction solar cell are discussed. B.G.

N86-31100# Department of the Army, Washington, D. C.
ELECTROLYTE FOR USE IN HIGH ENERGY LITHIUM BASED RECHARGEABLE ELECTROCHEMICAL CELL AND RECHARGEABLE ELECTROCHEMICAL CELL INCLUDING THE ELECTROLYTE Patent Application
Robert J. Mammone and Michael Binder, inventors (to Army) Filed 17 Apr. 1986 12 p
(AD-D012310; US-Patent-Appl-SN-855855) Avail: NTIS HC A02/MF A01 CSCL 03B

The general object of this invention is to provide a lithium based rechargeable electrochemical cell having an improved capacity. A more specific object of the invention is to provide an electrolyte for such a cell. A still further object of the invention is to provide such a cell. A still further object of the invention is to provide such a rechargeable electrochemical cell that permits the oxidation of dithionite to occur without using chlorine as an intermediate oxidizing agent. It has now been found that the aforementioned objects can be attained by providing an electrolyte including bromine dissolved in the liquid complex Li(s02)3A1C14. GRA

N86-31101# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
SYSTEM PERFORMANCE ANALYSIS OF STRETCHED MEMBRANE HELIOSTATS
J. V. Anderson, L. M. Murphy, W. Short, and T. Wendelin Dec. 1985 8 p Presented at the ASME Solar Energy Division Conference, Anaheim, Calif., 14 Apr. 1986
(Contract DE-AC02-83CH-10093)
(DE85-016885; SERI/TP-253-2819; CONF-860406-5) Avail: NTIS HC A02/MF A01

The optical performance of both focused and unfocused stretched membrane heliostats was examined in the context of the overall cost and performance of central receiver systems. The sensitivity of optical performance to variations in design

parameters such as the system size (capacity), delivery temperature, heliostat size, and heliostat surface quality was also examined. The results support the conclusion that focused stretched membrane systems provide an economically attractive alternative to current glass/metal heliostats over essentially the entire range of design parameters studied. In addition, unfocused stretched membrane heliostats may be attractive for a somewhat more limited range of applications, which would include the larger plant sizes (e.g., 450 MW) and lower delivery temperatures (e.g., 450(0)C), or situations in which the heliostat size could economically be reduced. DOE

N86-31102# PSE and G Research Corp., Newark, N.J.
TECHNICAL AND ECONOMIC ASSESSMENTS OF ELECTROCHEMICAL ENERGY STORAGE SYSTEMS. VOLUME 1: EXECUTIVE SUMMARY Final Report, Sep. 1978 - May 1985
J. L. DelMonaco, M. P. Bhavaraju, and A. W. Quade 1 Aug. 1985 63 p
(Contract DE-AC02-78ET-26950)
(DE86-006855; DOE/ET-26950/1-Vol-1) Avail: NTIS HC A04/MF A01

Results show that it is technically feasible to use the four types of batteries (ZnCl2, Na2S, ZnBr2 and Pb/acid) as load-leveling energy storage devices. In terms of short circuit impact, stability and reliability, no adverse problems were uncovered. Economic benefits of using batteries for load-leveling are marginal. Preliminary assessment of possible cost reductions in battery cost estimates show that batteries can be economical for some load-leveling applications. The relationship of battery breakeven cost vs battery system cost projections indicates that some types of battery systems would be economical for peaking duty, compared with combustion turbines (CT's). Since one of the battery systems studied had the lowest estimated installed cost and the highest breakeven cost, it would justify up to a 3% penetration. Initial estimates indicate that several battery systems are clearly not competitive with CT's, or only competitive at low penetration levels. Battery breakeven costs decline with increasing battery penetration. However, this trend is in step with the reduced unit costs which will hopefully be achieved with maturing production processes. Potential for cost reduction is estimated at about 25%. DOE

N86-31103# SOLAC Builders Ltd., Albuquerque, N. Mex.
DEVELOPMENT OF AN ELASTIC-IMPULSE POWER TRANSMISSION FOR WIND ENERGY CONVERSION SYSTEMS Final Report
B. Pahl Jan. 1986 43 p
(DE86-900708; NMERDI-2-73-4627) Avail: NTIS HC A03/MF A01

A multiload-capable elastic-impulse power transmission for use in Wind Energy Conversion Systems (WECS) was designed, prototype constructed and bench tested. The transmission interposes a temporary energy storage device between the input and output shafts, and therefore allows the two shafts to rotate at virtually independent speeds. For utility interface induction generators which must run at essentially constant speed, the transmission allows the turbine rotor to run at variable speed, thereby maintaining the constant tip-speed ratio corresponding to the peak-power point. The transmission was found to work in principle, but the first construction prototype exhibited low efficiencies (24%) due to the constraints imposed by the utilization of commercial components. DOE

N86-31104# Oak Ridge National Lab., Tenn.
NUMERICAL STUDY OF THE PERFORMANCE OF LATENT HEAT STORAGE FOR SOLAR DYNAMIC POWER SYSTEMS
A. D. Solomon Jan. 1986 23 p
(Contract DE-AC05-84OR-21400)
(DE86-006748; ORNL-6218) Avail: NTIS HC A02/MF A01

A conceptual design of a space station power system based on a Brayton cycle and solar powered has been developed. A key component of such a system is the thermal energy storage module, which is of crucial importance during periods of darkness. We have developed a computer program, FPAK1.F, simulating one possible storage design. We describe the code and, using it, raise some questions about the system under study. DOE

N86-31105# Oak Ridge National Lab., Tenn. Engineering Technology Div.
SPACE POWER USING SOLAR PHOTOVOLTAIC PANELS: COSTS AND LIMITATIONS
Kent A. Williams Mar. 1986 80 p
(Contract DE-AC05-84OR-21400)
(DE86-008953; ORNL/TM-9856) Avail: NTIS HC A05/MF A01

Solar photovoltaic panels (SPPs) have been suggested as a possible prime space power source for multi-kilowatt applications within a ballistic missile defense (BMD) system. As a first step in an attempt to assess the affordability of possible BMD space power sources, the limitations and costs of space power satellites using SSPs in conjunction with an electrochemical energy storage system have been investigated. Both high and low earth orbital missions are considered. An extensive literature search was conducted to determine values for the principal technology-driven performance and cost figures of merit. A small computer code was then developed to evaluate the total power cost, including launch, in dollars per watt of desired space power load. The unit costs obtained were found to be heavily influenced by the nature of the mission (altitude) and the attainable specific power for the two major system components. DOE

N86-31106# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
PROCEEDINGS OF THE HIGH-EFFICIENCY PHOTOVOLTAIC SUBCONTRACTOR'S REVIEW MEETING
Jan. 1986 210 p Meeting held in Lakewood, Colo., 12-13 Sep. 1985
(Contract DE-AC02-83CH-10093)
(DE86-004415; SERI/CP-211-2875) Avail: NTIS HC A10/MF A01

Separate abstracts were prepared for 20 papers in these proceedings. Topics covered include high-efficiency solar cell concepts and crystalline silicon. DOE

N86-31107# Johnson Controls, Inc., Milwaukee, Wis. Globe Battery Div.
RESEARCH, DEVELOPMENT AND DEMONSTRATION OF LEAD-ACID BATTERIES FOR ELECTRIC VEHICLE PROPULSION Annual Report, 1985
D. E. Bowman Mar. 1986 32 p
(Contract W-31-109-eng-38)
(DE86-008518; ANL-86-12) Avail: NTIS HC A03/MF A01

Cycle life of the 15-electrode Advanced-1 design, utilizing the all lead-plastic grids, was increased from less than 150 to 296 cycles (C-420) by using an additive to strengthen the positive active material (PAM). This cell demonstrated a specific energy of 44.6 Wh/kg at the C/3 rate. The utilization of the PAM was increased from 45.2 Ah/1b PAM to 58.4 Ah/1b PAM. The 58.4 Ah/1b value represents an increase of 91% in the utilization as compared to an EV-2300 at the same rate. The flow-through cell operates in an oxygen recombination mode and the cell design controls the efficiency of the recombination. The main failure mode of the cells was the loss of the preferred structure of the PAM, resulting in the cracking and dislodging of pellets. A secondary failure mode is the change of the physical and chemical properties of the negative active material. A new, cell component (diffuser) increased the uniformity of the electrolyte flow through the positive electrode. Die cutting Lexan sheet stock reduced test cell building labor costs by 75%. A 3-electrode screening cell design was develope d which utilizes a gasketing material to seal the assembly. DOE

N86-31108# California Univ., Berkeley. Lawrence Berkeley Lab.
BIMETALLIC FUEL CELL CATALYSTS
B. C. Beard and P. N. Ross Dec. 1985 68 p
(Contract DE-AC03-76SF-00098)
(DE86-009259; LBL-20741) Avail: NTIS HC A02/MF A01

Platinum electrocatalysts alloyed with various transition metals

have been found to give improved acid fuel cell performance over pure Pt catalyst electrodes. This study has investigated the chemical and structural environment of the transition metal in the alloy catalyst. EXAFS analysis is an ideal structural probe of the lattice of these low concentration (10 wt % Pt with ca. 1 wt % transition metal) supported catalysts. EXAFS analysis of such materials has been run. DOE

N86-31109# Technical Research Centre of Finland, Espoo.
WIND ENERGY IN ELECTRIC POWER PRODUCTION, PRELIMINARY STUDY
R. Lento and E. Peltola Jan. 1984 134 p In FINNISH
(DE86-751566; VTT-TIED-282) Avail: NTIS (US Sales Only) HC A07/MF A01

The wind speed conditions in Finland have been studied with the aid of the existing statistics of the Finnish Meteorological Institute. With the aid of the statistics estimates on the available wind energy were also made. Eight hundred wind power plants, 1.5 MW each, on the windiest west coast would produce about 2 TWh energy per year. Far more information on the temporal, geographical and vertical distribution of the wind speed than the present statistics included is needed when the available wind energy is estimated, when wind power plants are dimensioned optimally, and when suitable locations are chosen for them. The investment costs of a wind power plant increase when the height of the tower or the diameter of the rotor is increased, but the energy production increases, too. Thus, overdimensioning the wind power plant in view of energy needs or the wind conditions caused extra costs. The cost of energy produced by wind power can not yet compete with conventional energy, but the situation changes to the advantage of wind energy, if the real price of the plants decreases (among other things due to large series production and increasing experience), or if the real price of fuels rises. The inconvinience on the environment caused by the wind power plants is considered insignificant. The noise caused by the plant attenuates rapidly with distance. No harmful effects to birds and other animals caused by the wind power plants have been observed in the studies made abroad. Parts of the plant getting loose during an accident, or ice forming on the blades are estimated to fly even from a large plant only a few hundred meters. DOE

N86-31110# Sandia National Labs., Albuquerque, N. Mex.
DETERMINATION OF OPTIMUM MOUNTING CONFIGURATIONS FOR FLAT-PLATE PHOTOVOLTAIC MODULES BASED ON A STRUCTURED FIELD EXPERIMENT AND SIMULATED RESULTS FROM PVFORM, A PHOTOVOLTAIC SYSTEM PERFORMANCE MODEL
D. F. Menicucci Jan. 1986 42 p
(Contract DE-AC04-76DP-00789)
(DE86-009539; SAND-85-1251) Avail: NTIS HC A03/MF A01

The performance of a photovoltaic (PV) system is affected by its mounting configuration. The optimal configuration is unclear because of lack of experience and data. Sandia National Laboratories, Albuquerque (SNLA), has conducted a controlled field experiment to compare four types of the most common module mounting. The data from the experiment were used to verify the accuracy of PVFORM, a new computer program that simulates PV performance. PVFORM was then used to simulate the performance of identical PV modules on different mounting configurations at 10 sites throughout the US. This report describes the module mounting configurations, the experimental methods used, the specialized statistical techniques used in the analysis, and the final results of the effort. The module mounting configurations are rank ordered at each site according to their annual and seasonal energy production performance, and each is briefly discussed in terms of its advantages and disadvantages in various applications. DOE

N86-31111# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
FALLING FILM FLOW CHARACTERISTICS OF THE DIRECT ABSORPTION RECEIVER
T. A. Newell, K. Y. Wang, and R. J. Copeland Mar. 1986 57 p
(Contract DE-AC02-83CH-10093)
(DE86-004432; SERI/TR-252-2641) Avail: NTIS HC A04/MF A01

This report examines the characteristics of a thin, falling film used in a direct absorption receiver, investigates the system performance, and discusses the flow similarities between water and salt. In this receiver concentrated radiation is directly absorbed within a thin layer of molten carbonate salt flowing down near vertical wall. System capacities of 25 to 360 MW/sub t/ were analyzed. The experiments were isothermal; therefore, heat transfer characteristics were determined from film shear stress. A 25 MW/sub t/ receiver at a high turn-down ratio (5:1) marginally violates a film breakdown criterion. At high film flow rates gas and liquid interactions can cause a droplet removal phenomenon. Neither of these should affect film flow stability. Film thickness is also important in predicting operating characteristics. A rough wall surface significantly enhances wall-to-film heat transfer, but the roughness height should not exceed what the film's thickness would be over a smooth surface. In general, a molten carbonate salt film should be stable over the anticipated range of receiver capacities and operating conditions. Only small systems at low flow conditions may be near a critical opration limit. DOE

N86-31112# Varian Associates, Palo Alto, Calif. Device Lab.
DEVELOPMENT OF A THIN AgaAs SOLAR CELL
G. F. Virshup and J. G. Werthen Mar. 1986 30 p
(Contract DE-AC04-76DP-00789)
(DE86-009544; SAND-86-7027) Avail: NTIS HC A03/MF A01

A process for fabricating thin AlGaAs solar cells suitable for use as the top cell in a mechanically stacked, cascade cell has been developed. Significant progress was achieved in optimization of the AlGaAs cell structure with one-sun efficiencies of 17% (AM1.5, 100 mW/cm(2)) for 1.65-eV cells and efficiencies around 18% under concentration (200X to 800X) for 1.72-eV cells. Removal of the GaAs substrate had a very low yield, but new methods that should improve the yields have been identified. DOE

N86-31113# Oak Ridge National Lab., Tenn.
DEVELOPMENT OF A SIMULATION CODE FOR A LATENT HEAT THERMAL ENERGY STORAGE SYSTEM IN A SPACE STATION
A. D. Solomon, M. D. Morris, J. Martin, and M. Olszewski Apr. 1986 48 p
(Contract DE-AC05-84OR-21400)
(DE86-010070; ORNL-6213) Avail: NTIS HC A03/MF A01

A conceptual design of a space station power system based on a Brayton cycle and solar powered has been developed. A key part of such a system is the thermal energy storage module, which is of crucial importance during periods of darkness. We have developed a simulation code for one possible storage configuration. In this report, we describe the considerations entering into the code development, and some results obtained thus far. DOE

N86-31114# Brookhaven National Lab., Upton, N. Y. Dept. of Applied Science.
FUEL CELL REACTIONS IN SUPER ACID ELECTROLYTES Final Report, Jun. 1982 - Dec. 1985
William E. OGrady Jan. 1986 95 p
(Contract GRI-5081-260-0584)
(PB86-201084; GRI-86/0058) Avail: NTIS HC A05/MF A01 CSCL 10B

The series of acids including CF3SO3H, C4F9SO3H, CF2(SO3H)2, (CF2SO3H)2, (CF2)2(SO3H)2,(CF2)3(SO3H)2,(CF2)4(SO3H)2, (CF3SO2)2NH, C6F5SO3H, SF5CHFSO3H, (CF3SO2)2CH2, CF3CFHCF2SO3H, C5F11CHFCF2SO3H, CF3PO(OH)2, CH3PO(OH)2, (CF3)2POOH and CF2(PO3H2)2 have been tested as fuel cell electrolytes. Oxygen reduction activity on platinum has been examined in each of the electrolytes. The conductivity as a function of the temperature has been examined in a number of them. All unusual entropy change occuring at the hydrogen electrode was observed in the perfluorosulfonic acids which is a function of the acid concentration. GRA

N86-30796# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Space Div.
DESIGN AND DEVELOPMENT OF THE ADVANCED RIGID ARRAY (ARA) SOLAR PANEL
R. W. H. Horsselenberg *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 319-328 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-31418*# Prairie View Agricultural and Mechanical Coll., Tex. Dept. of Electrical Engineering.
AN IBM PC-BASED MATH MODEL FOR SPACE STATION SOLAR ARRAY SIMULATION
Ervin M. Emanuel *In* NASA. Johnson Space Center NASA/ American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 28 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 10A

N86-31430*# South Carolina Univ., Columbia. Dept. of Mechanical Engineering.
THERMALLY REGENERATIVE HYDROGEN/OXYGEN FUEL CELL POWER CYCLES
Jeffrey H. Morehouse *In* NASA. Johnson Space Center NASA/ American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 28 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 10B

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N86-31115# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
GROUND BASED OZONE MEASUREMENTS IN AN EQUATORIAL RAINFOREST
Volker W. J. H. Kirchhoff Apr. 1986 30 p Presented at the Spring AGU Meeting, Baltimore, Md., 19-23 May 1986 Sponsored by the Fundo Nacional de Desenvolvimento Cientifico e Tecnologico
(INPE-3858-PRE-922) Avail: NTIS HC A03/MF A01

Ozone concentrations have been measured in Manaus (3 deg. S, 60 deg. W) during NASA's ABLE expedition of July 1985. Diurnal variations of surface ozone were measured using UV surface ozone sensors, and 14 ozonesondes were launched to obtain vertical profiles of ozone in the troposphere and stratosphere. The diurnal variations are rather strong. At night it is not uncommon to obtain zero mixing ratios, diurnal values being around 10-20 ppbv, maximizing around 13 L.T. Tropospheric mixing ratios are much lower than at Natal (6 deg. S, 35 deg. W), and the mixing ratio gradient close to the ground is more than twice as large as at Natal. Author

N86-31116*# Maryland Univ., College Park. Dept. of Chemistry.
VOLCANIC IMPACT ON STRATOSPHERIC AEROSOL CHEMISTRY Final Report, Mar. 1980 - Dec. 1983
William H. Zoller 1984 16 p
(Grant NAG2-28)
(NASA-CR-176901; NAS 1.26:176901) Avail: NTIS HC A02/MF A01 CSCL 13B

Samples collected by the National Center for Atmospheric Research (NCAR) using the multiple-filter sampler on the U-2 were analyzed. The sampler is capable of exposing a number of 110 mm filters in sequence to ram air flow. Two types of filters, IPC cellulose and polystrene, were used, both of which have high blank levels for the trace elements determined. The levels of most trace elements in the stratosphere are so low under normal circumstances that none can be seen. Results from the eruption of Mt. St. Helens, a mystery cloud (probably volcanic in origin) in 1982, and the El Chichonal eruption in 1983 are discussed. To improve the collection of particles for chemical analysis, a new sampling system was developed for use on the U-2. The sampler consisted of an electrostatic collection of particles between 1 and 0.001 micron diameter dierectly onto electron microscopic grids, followed by a thermal precipitation for the smaller particles. The system was built and tested in the laboratory, but never flown on the U-2. B.G.

N86-31117# Brookhaven National Lab., Upton, N. Y.
ACID DEPOSITION: A NATIONAL PROBLEM
George R. Hendrey 1985 15 p Presented at the Acid Deposition: Environmental, Economic, and Policy Issues, Plattsburgh, N.Y., 10 Jun. 1983
(Contract DE-AC02-76CH-00016)
(DE86-007810; BNL-36875; CONF-8306288-1) Avail: NTIS HC A02/MF A01

The deposition of excessive quantities of sulfur and nitrogen from the atmosphere constitutes a problem encompassing all of the United States east of the Mississippi River. It also occurs in some areas of the western US. Calculations based on emission inventories and simplifying assumptions indicate electric utilities account for 66% of SO2 emissions, 29% of NO/sub x/ emissions and about half of precipitation acidity. Acidification of clearwater lakes and streams is a widespread problem only in areas receiving rain with an average acidity less than or equal to 4.7. The dominant anion in such waters is SO4(2-) and concentrations of aluminum derived from watershed acidification may exceed 200 (MU)g 1(-1). Changes in assemblages of aquatic biota become increasingly apparent as pH decreases below 6.0, and elimination of fish from some waters has been documented. The sensitivity of surface saters is controlled by and represents an integration of biogeochemical processes in their edaphic settings. Changes in surface water chemistry imply changes in the terrestrial environment. Direct evidence of changes in terrestrial environments is sparse. Nevertheless, observations of forest dieback in the US and abroad suggest that acid deposition may contribute to the problem. Very few credible studies are available which allow an evaluation of acid precipitation effects on crops. DOE

N86-31118# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna. Hauptabteilung Umwelttechnik und Additivenergier.
DEVELOPMENTS AND TRENDS IN ENVIRONMENTAL PROTECTION
Edgar Cabela Dec. 1985 27 p In GERMAN; ENGLISH summary
(OEFZS-4342; NU-18/85; ESA-86-97245) Avail: NTIS HC A03/MF A01

Developments in the field of environmental problems are reviewed. Attention is drawn to the present and future main areas of global environmental hazards. Possible strategies and technological solutions for environmental protection and restoration are discussed. ESA

N86-31433*# University of Southeastern Louisiana, Hammond. Dept. of Biological Sciences.
IN VITRO CYTOGENETIC STUDIES OF ORGANIC CHEMICALS FOUND AS CONTAMINANTS IN SPACECRAFT CABIN ATMOSPHERES
Joseph Torres *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 6 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 13B

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N86-31119*# Lunar and Planetary Inst., Houston, Tex. Publications Office.

PAPERS PRESENTED TO THE CONFERENCE ON HEAT AND DETACHMENT IN CRUSTAL EXTENSION ON CONTINENTS AND PLANETS

1985 169 p refs Conference held in Sedona, Ariz., 10-12 Oct. 1985; sponsored by Lunar and Planetary Inst., Geological Survey, American Geophysical Union, Geological Society of America, and Rio Grande Rift Consortium

(Contract NASw-3389)

(NASA-CR-176837; NAS 1.26:176837; LPI-Contrib-575) Avail: NTIS HC A08/MF A01 CSCL 08G

Several topics relative to heat and detachment in crustal extension on continents and planets are discussed. Rifting on Venus, heat flow and continental breakup, magnetism, the mountains and tectonic processes of Io, and the ductile extension of planetary lithospheres are among the topics covered. For individual titles, see N86-31120 through N86-31165.

N86-31120*# Pittsburgh Univ., Pa. Dept. of Geology and Planetary Science.

EXTENT AND CHARACTER OF EARLY TERTIARY PENETRATIVE DEFORMATION, SONORA, NORTHWEST MEXICO

T. H. Anderson *In* Lunar and Planetary Inst. Papers presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 1 (For primary document see N86-31119 22-46)

Avail NTIS HC A08/MF A01 CSCL 08G

Reconnaissance field work has led to the recognition of extensive Early Tertiary gneiss and schist which are distinguished by weakly developed to highly conspicous northeast to east-trending stretching lineation commonly accompanied by low-dipping foliation. This structural fabric has been imposed on Precambrian to Paleogene rocks. Regionally, minimum ages of deformation are based upon interpreted U-Pb isotopic ages from suites of cogenetic zircon from the Paleogene orthogneiss. Locally, the interpreted ages indicate that ductile deformation continued as late as Oligocene (Anderson and others, 1980; Silver and Anderson, 1984). The consistency of the deformational style is such that, although considerable variation in intensity exists, the fabric can be recognized and correlated in rocks away from the Paleogene orthogneiss. Author

N86-31121*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

RIFTING ON VENUS: IMPLICATIONS FOR LITHOSPHERIC STRUCTURE **c91**

W. B. Banerdt and M. P. Golombek *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 2 (For primary document see N86-31119 22-46)

Avail: NTIS HC A08/MF A01 CSCL 08G

Lithospheric strength envelopes on Venus are reviewed and their implications for large scale rifting are discussed. Their relationship to crustal thicnesses and thermal gradients are explored. Also considered are the implications of a theory for rift formation. Author

N86-31122*# AMAX Exploration, Inc., Tucson, Ariz.

THERMAL REGIMES IN THE DETACHMENT FAULT ENVIRONMENT AS DEDUCED FROM FLUID INCLUSIONS

Richard E. Beane, Joe Wilkins, Jr. (Saint Joe American, Tucson, Ariz.), and Tom L. Heidrick (Gulf Oil Corp., Bakersfield, Calif.) *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 7-9 (For primary document see N86-31119 22-46)

Avail: NTIS HC A08/MF A01 CSCL 08G

Extensional tectonism, which dominates middle- and late-Tertiary geology in western Arizona, southeastern California, and southern Nevada, is characterized by normal regionally extensive, low-angle detachment faults. The decollement movement of Fupper plate rocks relative to lower plate assemblages created extensive zones of dilatency, including synthetic and antithetic listric normal faults, tear faults, tectonic crush breccias, shatter breccias, and gash veins in lithologic units above and below the detachment. The tectonically enhanced permeability above and below the detachment fault permitted mass migration of large volumes of hydrothermal solutions along the fault zone during and following upper plate movement. Major quantities of MgO, CaO, K2O, FeO/Fe2O3, SiO2 and CO2 were added to rocks in and near the detachment and related structures. Also introduced were varying amounts of trace elements including Mn, Cu, S, Mo, Ba, Au, Pb, Zn, U and/or Ag. Minerals containing fluid inclusions were collected from all of these loci at locations in detachment faulted terranes in western Arizona and southeastern California. Author

N86-31123*# Tel-Aviv Univ. (Israel). Dept. of Geophysics and Planetary Sciences.

HEAT FLOW AND CONTINENTAL BREAKUP: THE GULF OF ELAT (AQABA)

Zvi Ben-Avraham and Richard P. VonHerzen (Woods Hole Oceanographic Institution, Mass.) *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 10-11 (For primary document see N86-31119 22-46)

Avail: NTIS HC A08/MF A01 CSCL 08G

Heat flow measurements were made in the major basins of the Gulf of Elat (Aqaba), northern Red Sea. The gulf is located at the southern portion of the Dead Sea rift which is a transform plate boundary. Gradient measurements at each site were made with a probe which allows multiple penetration of the bottom during a single deployment of the instrument. Thermal conductivity was determined by needle probe measurements on sedimentary cores. The mean heat flux, about 80 mWm(-2), is significantly above the continental mean, and probably also above that from the adjacent Sinai and Arabian continental blocks. The heat flow appears to increase from north to south. Such an increase may be related to the more advanced rifting stage of the Red Sea immediately to the south, which presently includes creation of an oceanic crust. This trend also corresponds to the general trend of the deep crustal structure in the gulf. Evidence from various geophysical fields suggest a gradual thinning of the crust towards the direction of the Red Sea where a normal oceanic crust exists. The heat flow data, together with other geophysical data, indicate a propagation of mature rifting activity from the Red Sea into the Gulf of Elat. This process is acting simultaneously with the transform motion along the Dead Sea rift. Author

N86-31124*# Southern Methodist Univ., Dallas, Tex. Dept. of Geological Sciences.

EVOLUTION OF BASIN AND RANGE STRUCTURE IN THE RUBY MOUNTAINS AND VICINITY, NEVADA

D. D. Blackwell, N. M. Reese, and S. A. Kelley *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 12-14 (For primary document see N86-31119 22-46)

Avail: NTIS HC A08/MF A01 CSCL 08G

Results from various age dating techniques, seismic reflection profiling hydrocarbon maturation studies, and structural analysis were used to evaluate the Cenozoic deformation in the Ruby Mountains and adjoining ranges (pinyon Range and Cortez Range) in Elko and Eureka Counties, Nevada. Age dating techniques used include potassium-argon ages of biotites from granites published by Kistler et al. (1981) and fission track ages from apatite and zircon. Fission track ages from apatite reflect a closing temperature of 100 plus or minus 20 deg C. Zircon fission track ages reflect a closing temperature of 175 plus or minus 25 deg C and potassium-argon ages from brotite reflect a closing temperature of 250 plus or minus 30 deg C. Thus these results allow a reasonably precise

tracking of the evolution of the ranges during the Cenozoic. Seismic reflection data are available from Huntington Valley. Access to seismic reflection data directly to the west of the Harrison Pass Pluton in the central Ruby Mountains was obtained. In addition results are available from several deep exploration holes in Huntington Valley. Author

N86-31125*# University of Southern Mississippi, Hattiesburg. Dept. of Geology.
LATE CRETACEOUS EXTENSIONAL TECTONICS AND ASSOCIATED IGNEOUS ACTIVITY ON THE NORTHERN MARGIN OF THE GULF OF MEXICO BASIN
R. L. Bowen and D. A. Sundeen *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 15-17 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

Major, dominantly compressional, orogenic episodes (Taconic, Acadian, Alleghenian) affected eastern North America during the Paleozoic. During the Mesozoic, in contrast, this same region was principally affected by epeirogenic and extensional tectonism; one episode of comparatively more intense tectonic activity involving extensive faulting, uplift, sedimentation, intrusion and effusion produced the Newark Series of eposits and fault block phenomena. This event, termed the Palisades Disturbance, took place during the Late Triassic - Earliest Jurassic. The authors document a comparable extensional tectonic-igneous event occurring during the Late Cretaceous (Early Gulfian; Cenomanian-Santonian) along the southern margin of the cratonic platform from Arkansas to Georgia. Author

N86-31126*# Geological Survey, Denver, Colo.
A REGIONAL 17-18 MA THERMAL EVENT IN SOUTHWESTERN ARIZONA
William E. Brooks *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 18-21 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

A regional thermal event in southwestern Arizona 17 to 18 Ma ago is suggested by discordances between fission track (FT) and K-Ar dates in Tertiary volcanic and sedimentary rocks, by the abundance of primary hydrothermal orthoclase in quenched volcanic rocks, and by the concentration of Mn, Ba, Cu, Ag, and Au deposits near detachment faults. A high condont alteration index (CAI) of 3 to 7 is found in Paleozoic rocks of southwestern Arizona. The high CAI may have been caused by this mid-Tertiary thermal event. Resetting of temperature-sensitive TF dates (2) 17 to 18 Ma with respect to K-Ar dates of 24 and 20 Ma has occurred in upper plate volcanic rocks at the Harcuvar and Picacho Peak detachments. Discordances between FT and K-Ar dates are most pronounced at detachment faults. However, on a regional scale Ft dates from volcanic and sedimentary rocks approach 17 to 18 Ma event in areas away from known detachment faults. Effects of detachment faulting on the K-Ar system suggest that dates of correlative rocks will be younger as the detachment fault is approached. Author

N86-31127*# University of Northern Arizona, Flagstaff. Dept. of Geology.
GEOMETRIC AND CHRONOLOGIC EVOLUTION OF THE VERDE AND PAYSON BASINS OF CENTRAL ARIZONA AND POSSIBLE RELATIONSHIPS TO DETACHMENT FAULTING
D. S. Brumbaugh *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 22-24 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

The Transition Zone of Arizona and the structural basins therein have been poorly understood features from a structural standpoint. This is true both of their overall geometry as well as their formation. Yet these basins have developed within the last 13 million years and thus represent perhaps the most recent phase of development related to the extensional tectonics of the Basin and Range province. Recent work (Smith, 1984; Vance, 1983) as well as some older studies (Anderson and Creasy, 1985; Pedersen and Royce, 1970) provide data on the geometry of the Verde and Payson basins which can be used to constrain some hypotheses related to the development of these basins. The work of Cloos (1868), Anderson et. al. (1983), Wernicke and Burchfiel (1982) and Davis et. al. (l980) suggest a spatial and chronologic relation exists between planar high angle normal faults and low angle detachment faults. Perhaps one of the clearest examples from the Basin and Range area appears to be from seismic reflection profiles of the Sevier Desert Basin area of Utah (Fig. 1). These profiles suggest the existence fault-controlled extension basin development above it. Faults that appear either listric or planar intersect it from above. Author

N86-31128*# New Mexico State Bureau of Mines and Mineral Resources, Socorro.
POTASSIUM METASOMATISM OF VOLCANIC AND SEDIMENTARY ROCKS IN RIFT BASINS, CALDERAS AND DETACHMENT TERRANES
C. E. Chapin and J. I. Lindley (North Carolina Univ., Chapel Hill.) *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 25-31 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

The chemical, mineralogical, and oxygen-isotopic changes accompanying K-metasomatism are described. The similarities with diagenetic reactions in both deep marine and alkaline, saline-lake environments are noted. The common occurrence of K-metasomatism in upper-plate rocks of detachment terranes indicates that the early stage of severe regional extension causes crustal downwarping and, in arid to semi-arid regions, development of closed hydrographic basins. Author

N86-31129*# Institut Francais du Petrole, Rueil-Malmaison.
EXTENSIONAL TECTONICS AND COLLAPSE STRUCTURES IN THE SUEZ RIFT (EGYPT)
P. Y. Chenet, B. Colletta, G. Desforges (Gameat Dowal Arabia, Cairo (Egypt).), E. Ousset, and E. A. Zaghloul *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 32-33 (For primary document see N86-31119 22-46)
Avail NTIS HC A08/MF A01 CSCL 08G

The Suez Rift is a 300 km long and 50 to 80 km wide basin which cuts a granitic and metamorphic shield of Precambrian age, covered by sediments of Paleozoic to Paleogene age. The rift structure is dominated by tilted blocks bounded by NW-SE normal faults. The reconstruction of the paleostresses indicates a N 050 extension during the whole stage of rifting. Rifting began 24 My ago with dikes intrusions; main faulting and subsidence occurred during Early Miocene producing a 80 km wide basin (Clysmic Gulf). During Pliocene and Quaternary times, faulting is still active but subsidence is restricted to a narrower area (Present Gulf). On the Eastern margin of the gulf, two sets of fault trends are predominant: (1) N 140 to 150 E faults parallel to the gulf trend with pure dip-slip displacement; and (2) cross faults, oriented NOO to N 30 E that have a strike-slip component consistent with the N 050 E distensive stress regime. The mean dip cross fault is steeper (70 to 80 deg) than the dip of the faults parallel to the Gulf (30 to 70 deg). These two sets of fault define diamond shaped tilted block. The difference of mechanical behavior between the basement rocks and the overlying sedimentary cover caused structural disharmony and distinct fault geometries. Author

N86-31130*# Arizona Univ., Tucson. Lunar and Planetary Lab.
TECTONIC DETERMINATIONS OF LITHOSPHERIC THICKNESS ON GANYMEDE AND CALLISTO c91
Steven K. Croft *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 34-37 (For primary document see N86-31119 22-46)

Avail: NTIS HC A08/MF A01 CSCL 08G

The concept of the Maxwell time of a viscoelastic material (4.5) is used in conjunction with calculated thermal profiles to evaluate the significance of tectonic estimates of lithospheric thickness. Thermal lithospheric thicknesses provide fundamental constraints on planetary thermal histories that complement the constraints provided by dateable surface deposits of endogenic origin. Lithospheric constraints are of particular value on the icy satellites where our understanding of both rheology and surface ages is considerably poorer than it is for the terrestrial planets. Certain extensional tectonic features can and have been used to estimate lithospheric thicknesses on Ganymede and Callisto. These estimates, however, refer to the depth of the elastic lithosphere defined by the zone of brittle failure. The relation between the elastic lithosphere and the thermal lithosphere (generally defined by the zone of conductive heat transport) is not straightforward, because the depth of brittle failure depends not only on the thermal profile, but also on rheology and strain rate (or the characteristic time over which stresses build towards failure). Characteristic time considerations are not trivial in this context because stresses generating brittle failure on the icy satellites may be produced by impacts, with characteristic times of seconds to days, or by geologic processes with time scales of hundreds of millions of years. Author

N86-31131*# Arizona Univ., Tucson. Dept. of Geosciences.

METAMORPHIC CORE COMPLEXES: EXPRESSION OF CRUSTAL EXTENSION BY DUCTILE-BRITTLE SHEARING OF THE GEOLOGIC COLUMN

G. H. Davis *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 38-39 (For primary document see N86-31119 22-46)

Avail: NTIS HC A08/MF A01 CSCL 08G

Metamorphic core complexes and detachment fault terranes in the American Southwest are products of stretching of continental crust in the Tertiary. The physical and geometric properties of the structures, fault rocks, and contact relationships that developed as a consequence of the extension are especially well displayed in southeastern Arizona. The structures and fault rocks, as a system, reflect a ductile-through-brittle continuum of deformation, with individual structures and faults rocks showing remarkably coordinated strain and displacement patterns. Careful mapping and analysis of the structural system has led to the realization that strain and displacement were partitioned across a host of structures, through a spectrum of scales, in rocks of progressively changing rheology. By integrating observations made in different parts of the extensional system, especially at different inferred depth levels, it has been possible to construct a descriptive/kinematic model of the progressive deformation that achieved continental crustal extension in general, and the development of metamorphic core complexes in particular. Author

N86-31132*# Louisiana State Univ., Baton Rouge. Dept. of Geology.

THERMAL HISTORY OF A METAMORPHIC CORE COMPLEX

Roy K. Dokka, Michael J. Mahaffie, and Arthur W. Snoke (Wyoming Univ., Laramie.) *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 40-41 (For primary document see N86-31119 22-46)

Avail: NTIS HC A08/MF A01 CSCL 08G

Fission track (FT) thermochronology studies of lower plate rocks of the Ruby Mountains-East Humbolt Range metamorphic core complex provide important constraints on the timing an nature of major middle Tertiary extension of northeast Nevada. Rocks analyzed include several varieties of mylonitic orthogneiss as well as amphibolitic orthognesses from the non-mylonitic infrastructural core. Oligocene-age porphyritic biotite granodiorite of the Harrison Pass pluton was also studied. The minerals dated include apatite, zircon, and sphene and were obtained from the same rocks that have been previously studied. FT ages are concordant and range in age from 26.4 Ma to 23.8 Ma, with all showing overlap at 1 sigma between 25.4 to 23.4 Ma. Concordancy of all FT ages from all structural levels indicates that the lower plate cooled rapidly from temperatures above approx. 285 C (assumed sphene closure temperature (2)) to below approx. 150 C (assumed apatite closure temperature) near the beginning of the Miocene. This suggests that the lower plate cooled at a rate of at least approx. 36 deg C/Ma during this event. Rapid cooling of the region is considered to reflect large-scale tectonic denudation (intracrustal thinning), the vertical complement to intense crustal extension. FT data firmly establish the upper limit on the timing of mylonitization during detachment faulting and also coincide with the age of extensive landscape disruption. Author

N86-31133*# Pennsylvania State Univ., University Park. Dept. of Geosciences.

THERMAL-MECHANICAL RESPONSE TO SIMPLE SHEAR EXTENSION

K. P. Furlong *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 42-44 (For primary document see N86-31119 22-46)

Avail: NTIS HC A08/MF A01 CSCL 08G

The mechanism of extension in the continental crust is apparently much more complex than that acting in the oceanic lithosphere. Recently, Wernicke has proposed that a significant fraction of extension in the continental lithosphere may occur by a simple shear mechanism along discrete fault/shear zones which cut the crust, and perhaps extend into the uppermost mantle. Clearly much of the surface evidence for extension supports this concept, but the depth extent of simple shear extension in the continental crust is unclear. Using numerical simulations, the thermal and associated mechanical behavior of the continental lithosphere in response to lithosphere extension along a low-angle simple shear zone which cuts through the lithospheric plate was determined in order to evaluate the resolving ability of thermal (heat flow and metamorphic P-T-time paths) and elevation observations in constraining the mode of continental extension. Author

N86-31134*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

LITHOSPHERIC STRENGTH OF GANYMEDE: CLUES TO EARLY THERMAL PROFILES FROM EXTENSIONAL TECTONIC FEATURES c91

M. P. Golombek and W. B. Banerdt *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 45-49 (For primary document see N86-31119 22-46)

Avail: NTIS HC A08/MF A01 CSCL 08G

While it is generally agreed that the strength of a planet's lithosphere is controlled by a combination of brittle sliding and ductile flow laws, predicting the geometry and initial characteristics of faults due to failure from stresses imposed on the lithospheric strength envelope has not been thoroughly explored. Researchers used lithospheric strength envelopes to analyze the extensional features found on Ganymede. This application provides a quantitative means of estimating early thermal profiles on Ganymede, thereby constraining its early thermal evolution. Author

N86-31135*# London Univ. (England). Dept. of Extra-Mural Studies.

IO: MOUNTAINS AND CRUSTAL EXTENSION

M. J. Heath *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 50-54 (For primary document see N86-31119 22-46)

Avail: NTIS HC A08/MF A01 CSCL 08G

It is argued that there is good reason to conclude that mountains on Io, like those on Earth, are subject to growth and decay. The decay of mountains will be assisted by the ability of SO sub 2 to rot silicate rock and by explosive escape of sub-surface SO sub 2 from aquifers (Haemus Mons is seen to be covered by bright material, presumably fallout from a SO sub 2 rich plume

which had been active on the mountain flanks). On the west side of the massif at 10 degrees S, 270 degrees W a rugged surface consists of long ridges running perpendicular to the downslope direction, suggesting tectonic denudation with crustal blocks sliding down the mountain flank. Tectonic denudation may be assisted, as in the case of the Bearpaw Mountains, Montana by overloading mountain flanks with volcanic products. The surfaces of some massifs exhibit a well developed, enigmatic corrugated terrain, consisting of complex ridge systems. Ridges may bifurcate, anastomose to form closed depressions and form concentric loops. Taken together, observations of morphology, heat flux, surface deposits and styles of volcanism may point to the existence of lithosphere domains with distinct compositions and tectonic regimes. Author

N86-31136*# New Mexico Inst. of Mining and Technology, Socorro.

PN VELOCITY BENEATH WESTERN NEW MEXICO AND EASTERN ARIZONA

Lawrence H. Jaksha *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 55-57 (For primary document see N86-31119 22-46)

Avail: NTIS HC A08/MF A01 CSCL 08G

The experiment involved observing Pn arrivals on an areal array of 7 seismic stations located in the transition zone and along the Jemez lineament. Explosions in coal and copper mines in New Mexico and Arizona were used as energy sources as well as military detonations at White Sands Missile Range, New Mexico, Yuma, Arizona, and the Nevada Test Site. Very preliminary results suggest a Pn velocity of 7.94 km/s (with a fairly large uncertainty) beneath the study area. The Pn delay times, which can be converted to estimates of crustal thickness given knowledge of the velocity structure of the crust increase both to the north and east of Springerville, Arizona. As a constraint on the velocity of Pn, researchers analyzed the reversed refraction line GNOME-HARDHAT which passes through Springerville oriented NW to SE. This analysis resulted in a Pn velocity of 7.9-8.0 km/s for the transition zone. These preliminary results suggest that a normal Pn velocity might persist even though the crust thins (from north to south) by 15 km along the length of the Arizona-New Mexico border. If the upper mantle is currently hot anywhere in western New Mexico or eastern Arizona then the dimensions of the heat source (or sources) might be small compared to the intra-station distances of the seismic arrays used to estimate the velocity of Pn. Author

N86-31137*# Geological Survey, Menlo Park, Calif.

BRITTLE EXTENSION OF THE CONTINENTAL CRUST ALONG A ROOTED SYSTEM OF LOW-ANGLE NORMAL FAULTS: COLORADO RIVER EXTENSIONAL CORRIDOR

Barbara E. John and Keith A. Howard *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 58 (For primary document see N86-31119 22-46)

Avail: NTIS HC A08/MF A01 CSCL 08G

A transect across the 100 km wide Colorado River extensional corridor of mid-Tertiary age shows that the upper 10 to 15 km of crystalline crust extended along an imbricate system of brittle low-angle normal faults. The faults cut gently down a section in the NE-direction of tectonic transport from a headwall breakaway in the Old Woman Mountains, California. Successively higher allochthons above a basal detachment fault are futher displaced from the headwall, some as much as tens of kilometers. Allochthonous blocks are tilted toward the headwall as evidenced by the dip of the cappoing Tertiary strata and originally horizontal Proterozoic diabase sheets. On the down-dip side of the corridor in Arizona, the faults root under the unbroken Hualapai Mountains and the Colorado Plateau. Slip on faults at all exposed levels of the crust was unidirectional. Brittle thinning above these faults affected the entire upper crust, and wholly removed it locally along the central corridor or core complex region. Isostatic uplift exposed metamorphic core complexes in the domed footwall. These data support a model that the crust in California moved out from under Arizona along an asymmetric, rooted normal-slip shear system. Ductile deformation must have accompanied mid-Tertiary crustal extension at deeper structural levels in Arizona. Author

N86-31138*# Wyoming Univ., Laramie. Dept. of Geology and Geophysics.

THERMOMECHANICAL MODELING OF THE COLORADO PLATEAU-BASIN AND RANGE TRANSITION ZONE

Michael D. Londe *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 59-63 (For primary document see N86-31119 22-46)

Avail: NTIS HC A08/MF A01 CSCL 08G

The Colorado Plateau (CP) basin and range (B & R) boundary is marked by a transition zone on the order of 75 to 150 km in width. As one moves westward across this transition from the CP interior to the B & R there is a variation in the surface topography, surface heat flow, Bouguer gravity, seismicity, and crustal structure. This transition extends eastward into the western CP from the Wastach-Hurricane fault line and is largely coincident with the high plateaus of Utah and the Wasatch Mountains. It has been suggested that this transition zone marks a thermal and tectonic encroachment of the CP by the B & R. A simple two dimensional numerical model of the thermal regime for the transition zone was constructed to test the hypothesis that the observed geophysical signatures across the transition are due to lateral heat conduction from steady state uniform extension within the B & R lithosphere. Surface heat flow, uplift due to flexure from thermal buoyant loading, and regional Bouguer gravity are computed for various extension rates, crustal structures, and compensation depths. Author

N86-31139*# Geological Survey, Flagstaff, Ariz.

HEAT AND DETACHMENT IN CORE-COMPLEX EXTENSION

Ivo Lucchitta *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 64-68 (For primary document see N86-31119 22-46)

Avail: NTIS HC A08/MF A01 CSCL 08G

It is proposed here that the Miocene to Recent structural and volcanic features of the Basin and Range Province can be explained by a single thermotectonic process acting through time. This process consists of a thermal pulse resulting in a high-temperature regime that includes a steep thermal front moving first up toward the topographic surface, then down owing to cooling induced by a combination of convection and conduction. Within the front is a condition defining a critical surface that separates brittle from ductile behavior, and is marked by a nearly horizonal detachment fault. The most prominent and structurally highest position of the detachment results from interaction between the critical surface and a hydrothermal system near the topographic surface. These various features can be superposed on older ones through thermal remobilization or structural reactivation. Author

N86-31140*# Georgia Inst. of Tech., Atlanta. School of Geophysical Sciences.

HEAT FLOW INCREASE FOLLOWING THE RISE OF MANTLE ISOTHERMS AND CRUSTAL THINNING

Jean-Claude Mareschal and George Bergantz *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension and Continents and Planets 1985 p 69-70 (For primary document see N86-31119 22-46)

Avail: NTIS HC A08/MF A01 CSCL 08G

Heat flow measurements in the western United States define a zone of high heat flow which coincides with the Basin and Range Province where extension has taken place recently. In this region, the average reduced heat flow is approx 30 mW sq. meters higher than in stable continental provinces; locally (e.g., Battle Mountain High), the heat flow anomaly can be more than 100 mW/sq meters above average. Estimates of the amount of extension range between 30% and 100% for the past 30 Ma. In the Colorado Plateau, which has been uplifted without major

tectonic deformation, the heat flow is only slightly above average. Analytical calculations show that an abrupt change in heat flow at the base of the lithosphere 30 Ma ago would not affect the surface significantly. Uplift would proceed at a slow rate. A thermal perturbation at the base of a 40 km thick crust, however, would reach the surface faster and, after 30 Ma, the increase in surface heat flow would be about 75% of the amplitude of the heat flow anomaly. The number of volcanic rocks in the Basin and Range suggests that magma intrusions may provide an effective heat transfer mechanism. It can be show that if the source of the intrusions is at the base of the lithosphere, the response time will be much longer than 30 Ma, and most ot the heat transferred from the asthenosphere will be absorbed in the lithosphere.
Author

N86-31141*# Texas A&M Univ., College Station. Dept. of Geology.
RELATIONS BETWEEN EXTENSIONAL TECTONICS AND MAGMATISM WITHIN THE SOUTHERN OKLAHOMA AULACOGEN
D. A. McConnell and M. C. Gilbert *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 71-75 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

Variations in the geometry, distribution and thickness of Cambrian igneous and sedimentary units within southwest Oklahoma are related to a late Proterozoic - early Paleozoic rifting event which formed the Southern Oklahoma aulacogen. These rock units are exposed in the Wichita Mountains, southwest Olkahoma, located on the northern margin of a Proterozoic basin. identified in the subsurface by COCORP reflection data. Overprinting of the Cambrian extensional event by Pennsylvanian tectonism obsured the influence of pre-existing basement structures and contrasting basement lithologies upon the initial development of the aulacogen.
Author

N86-31142*# Arizona State Univ., Tempe. Dept. of Geology.
HOT-SPOT TECTONICS ON IO **c91**
Alfred S. McEwen *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 76-80 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

The thesis is that extensional tectonics and low-angle detachment faults probably occur on Io in association with the hot spots. These processes may occur on a much shorter timescale on Ion than on Earth, so that Io could be a natural laboratory for the study of thermotectonics. Furthermore, studies of heat and detachment in crustal extension on Earth and the other terresrial planets (especially Venus and Mars) may provide analogs to processes on Io. The geology of Io is dominated by volcanism and hot spots, most likely the result of tidal heating. Hot spots cover 1 to 2% of Io's surface, radiating at temperatures typically from 200 to 400 K, and occasionally up to 700K. Heat loss from the largest hot spots on Io, such as Loki Patera, is about 300 times the heat loss from Yellowstone, so a tremendous quantity of energy is available for volcanic and tectonic work. Active volcanism on Io results in a resurfacing rate as high as 10 cm per year, yet many structural features are apparent on the surface. Therefore, the tectonics must be highly active.
Author

N86-31143*# Arizona Univ., Tucson. Lunar and Planetary Lab.
THE HEART MOUNTAIN FAULT: IMPLICATIONS FOR THE DYNAMICS OF DECOLLEMENT
H. J. Melosh *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 81-84 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

The Hart Mountain docollement in Northwestern Wyoming originally comprised a plate of rock up to 750m thick and 1300 sq kilometers in area. This plate moved rapidly down a slope no steeper than 2 deg. during Early Eocene time, transporting some blocks at least 50m from their original positions. Sliding occurred just before a volcanic erruption and was probably accompanied by seismic events. The initial movement was along a bedding plane fault in the Bighorn Dolomite, 2 to 3 meters above its contact with the Grove Creek member of the Snowy Range formation. The major pecularity of this fault is that it lies in the strong, cliff-forming Bighorn Dolomite, rather than in the weaker underlying shales. The dynamics of decollement are discussed.
Author

N86-31144*# Moscow State Univ. (USSR). Geological Faculty.
OCEANIC STRUCTURES OF THE EARTH AND THE NORTH DEPRESSION OF MARS: A COMPARISON OF THE FORMATION MECHANISMS
E. E. Milanovsky and A. M. Nikishin *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 85-88 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

The system of contemporary oceans on Earth and the North Depression of Mars are quasi-symmetrical in reference to the centers of of the hemispheres. Both systems had been formed over the common megacycle of evolution of planets and their origin is likely to have similar features. The formation of the Earth's oceanic system within the South Hemisphere seems to have proceeded in three stages: (1) the formation of a network of passive rifts at the center of the Gondwana; (2) the formation of the system of active rifts at the zones of forthcoming spreading; and (3) the spreading of the oceanic crust. The formation of the Mar's North Depression seems to have proceeded in two stages: (1) a formation of a dense network of grabens and faults at the center of the North Hemisphere over the upper mantle zone characterized by an anomalous warm-up and a density decrease; and (2) a collapse of the ancient crust and it's overflowing by basalts. The first stage of the ocean formation on Earth and Mars is similar. But there seems to have been a thinner lithosphere on Mars. The dense areal rifting was immediately followed by a total collapse.
Author

N86-31145*# Moscow State Univ. (USSR). Geological Faculty.
THE EVOLUTION OF RIFTING PROCESS IN THE TECTONIC HISTORY OF THE EARTH
E. E. Milanovsky and A. M. Nikishin *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 89-90 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

The continental rifting is the response of the lithosphere to the oriented tension. The distribution of viscosity in the lithosphere plays an essential role during all stages of the rifting. The viscosity is a function of the temperature, the lithostatic pressure, the rock composition, the deformation rate and other factors. The temperature is the most important factor. The vertical section of continental lithosphere of the rift zone may be divided into the following layers: the upper crust, in which brittle deformation prevails; the medial-crust, in which the role of plastic deformation increases; the lower crust, in which plastic deformation prevails; and the uppermost plastic part of the mantle overlapping asthenosphere. The depth of the boundaries in the crust layers are mainly controlled by the temperature.
Author

N86-31146*# Arizona State Univ., Tempe. Dept. of Geology.
EXTENSIONAL TECTONICS OF THE SATURNIAN SATELLITES **c91**
Jeffrey M. Moore *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 91-92 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

The saturnian satellites were imaged by the Voyager spacecraft at sufficient resolutions to reveal landforms that indicate histories of extensional tectonics for several of these bodies. The re-

lationships among landforms on various satellites imply that extensional tectonism is a consequence of several different energy sources. Case histories of several satellites are discussed to illustrate the interaction of various phenomena associated with extensional tectonism. Author

N86-31147*# Institut Francais du Petrole, Rueil-Malmaison.
LITHOSPHERIC AND CRUSTAL THINNING
I. Moretti *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 93-96 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

In rift zones, both the crust and the lithosphere get thinner. The amplitude and the mechanism of these two thinning situations are different. The lithospheric thinning is a thermal phenomenon produced by an asthenospherical uprising under the rift zone. In some regions its amplitude can exceed 200%. This is observed under the Baikal rift where the crust is directly underlaid by the mantellic asthenosphere. The presence of hot material under rift zones induces a large negative gravity anomaly. A low seismic velocity zone linked to this thermal anomaly is also observed. During the rifting, the magmatic chambers get progressively closer from the ground surface. Simultaneously, the Moho reflector is found at shallow depth under rift zones. This crustal thinning does not exceed 50%. Tectonic stresses and vertical movements result from the two competing effects of the lithospheric and crustal thinning. On the one hand, the deep thermal anomaly induces a large doming and is associated with extensive deviatoric stresses. On the other hand, the crustal thinning involves the formation of a central valley. This subsidence is increased by the sediment loading. The purpose here is to quantify these two phenomena in order to explain the morphological and thermal evolution of rift zones. Author

N86-31148*# Purdue Univ., West Lafayette, Ind. Dept. of Geosciences.
THERMAL CONTROL OF THE STYLE OF EXTENSIONAL TECTONICS
Paul Morgan *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 97-98 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

Crustal extension is accommodated by a wide range of structural styles ranging from high-angle normal faults to low-angle detachments. In some areas different structural styles are superposed by multiple extension events, and in other areas different structural styles are juxtaposed. As shown with examples from the Rio Grande rift and the Red Sea-Gulf of Aden rift system, high strains and low-angle faulting are commonly spatially and temporally associated with a hot and probably thin lithosphere as indicated by major magmatic activity. Theoretical studies of strength profiles in the lithosphere suggest that there may effectively be a critical range for the geotherm above which low-angle faulting and crustal decollement may be favored over high-angle faulting. Author

N86-31149*# Technische Univ., Clausthal-Zellerfeld (West Germany). Inst. fuer Geophysik.
EXTENSIONAL TECTONICS ON CONTINENTS AND THE TRANSPORT OF HEAT AND MATTER
Horst J. Neugebauer *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 99- 100 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

Intracontinental zones of extensional tectonic style are commonly of finite width and length. Associated sedimentary troughs are fault-controlled. The evolution of those structures is accompanied by volcanic activity of variable intensity. The characteristic surface structures are usually underlaid by a lower crust of the transitional type while deeper subcustal areas show delayed travel times of seismic waves especially at young tectonic provinces. A correspondence between deep-seated processes and zones of continental extension appears obvious. A sequential order of mechanisms and their importance are discussed in the light of modern data compilations and quantitative kinematic and dynamic approaches. The Cenozoic exensional tectonics related with the Rhine River are discussed. Author

N86-31150*# Moscow State Univ. (USSR). Geological Faculty.
ON THE DIFFERENCES IN CONTINENTAL RIFTING AT THE EARTH, MARS AND VENUS
A. M. Nikishin and E. E. Milanovsky *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 101 - 103 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

During the process of continental rifting on Earth, the lower ductile crust stretches, forming a neck, while the upper brittle crust is broken in blocks by faults, and the blocks sink down the thinned lower crust; if the stretching continues, the neck may break and a newly originated oceanic crust is formed at this place. The rift system structure depends on the depth of the boundary surface between the brittle crust and the ductile crust, the litospheric thickness, the tension value, etc.. The rigid brittle rifting when narrow necks form in the lower crust is characteristic of the contemporary Earth; on Mars the brittle rifting with large subsidence was characteristic of the Tharsis upland formation epoch. The ductile rifting is typical of the Venus. The differences in rheologic features of the lithospheres of different planets causes the variation in types of rifting. Author

N86-31151*# Los Alamos National Lab., N. Mex.
HEAT AND EXTENSION AT MID- AND LOWER CRUSTAL LEVELS OF THE RIO GRANDE RIFT
Kenneth H. Olsen, W. Scott Baldridge, and Jonathan F. Callender (New Mexico Univ., Albuquerque.) *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 104 - 105 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

The process by which large amounts (50 to 200 percent) of crustal extension are produced was concisely described by W. Hamilton in 1982 and 1983. More recently, England, Sawyer, P. Morgan and others have moved toward quantifying models of lithospheric thinning by incorporating laboratory and theoretical data on rock rheology as a function of composition, temperature, and strain rate. Hamilton's description identifies three main crustal layers, each with a distinctive mechanical behavior; brittle fracturing and rotation in the upper crust, discontinuous ductile flow in the middle crust and laminar ductile flow in the lower crust. The temperature and composition dependent brittle-ductile transition essentially defines the diffuse boundary between upper and middle crust. It was concluded that the heat responsible for the highly ductile nature of the lower crust and the lensoidal and magma body structures at mid-crustal depths in the rift was infused into the crust by relatively modest (< 10 percent by mass) magmatic upwelling (feeder dikes) from Moho levels. Seismic velocity-versus-depth data, supported by gravity modeling and the fact that volumes of rift related volcanics are relatively modest (< 6000 cubic km) for the Rio Grande system, all imply velocities and densities too small to be consistent with a massive, composite, mafic intrusion in the lower crust. Author

N86-31152*# South Carolina Univ., Columbia. Earth-Sciences and Resources Inst.
LOW-ANGLE NORMAL FAULTING AND ISOSTATIC RESPONSE IN THE GULF OF SUEZ: EVIDENCE FROM SEISMIC INTERPRETATION AND GEOMETRIC RECONSTRUCTION
S. K. Perry and S. Schamel *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 106 - 110 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

Tectonic extension within continental crust creates a variety of major features best classed as extensional orogens. These features have come under increasing attention in recent years, with the welding of field observation and theoretical concepts. Most recent advances have come from the Basin and Range Province of the southwestern United States and from the North Sea. Application of these geometric and isostatic concepts, in combination with seismic interpretation, to the southern Gulf of Suez, an active extensional orogen, allows generation of detailed structural maps and geometrically balanced sections which suggest a regional structural model. Geometric models which should prove to be a valuable adjunct to numerical and thermal models for the rifting process are discussed. Author

N86-31153*# Geological Survey, Reston, Va.
THE RELATIONSHIP OF EXTENSIONAL AND COMPRESSIONAL TECTONICS TO A PRECAMBRIAN FRACTURE SYSTEM IN THE EASTERN OVERTHRUST BELT, USA
Howard Pohn *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 111 - 112 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

The central and southern Appalachians have a long history of interrelated extensional and compressional tectonics. It is proposed that each episode was controlled by a reactivation of a fracture system in the Precambrian basement. Proprietary seismic-reflection profiles show a system of down-to-the-east Precambrian extensional faults. When under renewed extension, these faults produce features such as the western border faults of Mesozoic basins, and when under compression, probably produce tectonic ramps in the overlying sedimentary cover rocks as well as the spatially and genetically related Alleghenian folds. This system, which parallels the Appalachian trend, is cut by a system of cross-strike hinge or scissors faults that have probable strike-slip movements. Reactivation of this cross-strike system appears to have produced lateral ramps that connect decollements at different stratigraphic levels and caused abrupt changes in fold wavelength along strikes. Continued reactivation of this cross-strike system is suggested by east-west border faults and Precambrian highs between Mesozoic basins. The present activity of this system is suggested by the fact that more than 35% of recent earthquakes are coincident with cross-strike faults and lateral ramps. Author

N86-31154*# Brown Univ., Providence, R. I. Dept. of Geological Sciences.
LOW-ANGLE NORMAL FAULTS-LOW DIFFERENTIAL STRESS AT MID CRUSTAL LEVELS
W. L. Power *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 113 - 114 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

A simple model for frictional slip on pre-existing faults that considers the local stress state near the fault and the effect of non-hydrostatic fluid pressures predicts that low-angle normal faulting is restricted to areas of the crust characterized by low differential stress and nearly lithostatic fluid pressures. The model considers frictional slip on a cohesionless low-angle normal fault governed by the failure criterion tau = mu sub f (sigma (*) sub n) =mu sub f (sigma sub n - P sub f) where tau and sigma sub n are the shear and normal stresses across the fault plane, mu sub f is the static coefficient of friction, and P sub f is the pore fluid pressure. As a first approximation, the model considers a vertical greatest principal compressive stress, sigma sub 1. It is apparent that if slip on low-angle normal faults is governed by the avove frictional failure criterion, slip on the low-angle normal fault occurs only if the least effective principal stress, sigma (*) sub 3 = sigma sub 3 - P sub f, is tensile, whenever tan superscrip -1(mu sub f> d, where d is the dip of the fault. If detachment faulting occurs at any significant depth in the crust, P sub f> sigma sub 3 is required. In light of this conclusion I allow P sub f to vary as necessary to allow slip on the low-angle normal fault. Author

N86-31155*# Peking Univ. (China). Dept. of Geology.
LATE PRECAMBRIAN AULACOGENS OF THE NORTH CHINA CRATON
Xianglin Qian *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 115 - 117 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

According to tectonic styles, the Precambrian evolution history of the North China craton may be subdivided into four stages: (1) Archean consolidation in 3.5 to 2.5 Ga, (2) Early Proterozoic rifting in 2.5 to 1.8 Ga, (3) Late Precambrian aulacogen in 1.8 to 0.8 Ga and (4) Platform regime after 0.8 Ga. In the Late Precambrian aulacogen stage of the North China craton there were two main aulacogens, Yanliao and Zhongtiao (Y and Z), developed in Middle Proterozoic time with an age 1.8 to 1.0 Ga. Their NE trend caused them to meet together in the central part of the craton and build up one great Y-Z aulacogen throughout the craton. Author

N86-31156*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RADIAL RIFT AND BLOCK TECTONICS AROUND THE THARSIS BULGE: INTRODUCTIONAL POSTULATION
J. Raitala *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extention on Continents and Planets 1985 p 118 - 122 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

Although the Vallis Marineris canyon and radial fossae grabens have been extensively studied, their origin and formation mechanism is still the subject of numerous questions. Possible rift formation is only one point of view and does not explain the rifting mechanism and the radial pattern of these structures around the Tharsis bulge. Both active and passive rifting must be taken into account. According to the active mechanism the building of a colcanic complex like the Tharsis bulge is caused by the rising of a huge mantle plume and adjoining extrusions which tap the generated magma. The surrounding fossae and valley structures are caused by more passive crustal rifting due to tensional failure of the surface layers. The main rising mantle plume activated and regenerated failure patterns radial to the centre of activity. These radial zones of weakness are then most easily utilized by the rising mantle plume. Deep zones of weakness regulate the penetration and distribution of hot mantle rock into upper levels while, contrarily, the effective impingement of the hot mantle plume into the lithosphere opens up new weakness zones. Author

N86-31157*# New Mexico State Bureau of Mines and Mineral Resources, Socorro.
HEAT FLOW AND THERMAL PROCESSES IN THE JORNADA DELMUERTO, NEW MEXICO
Marshall Reiter *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 123 - 127 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

Most heat flow data in rifts are uncertain largely because of hydrologic disturbances in regions of extensive fracturing. Estimates of heat flow in deep petroleum tests within a large basin of the Rio Grande rift, which has suffered little syn-rift fracturing, may begin to provide clearer insight into the relationships between high heat flow and crustal thinning processes. The Jornada del Muerto is a large basin located in the Rio Grande rift of south central New Mexico. The region of interest within the Jornada del Muerto is centered about 30 km east of the town of Truth or Consequences, and is approximately 60 km north-south by 30 km east-west. High heat flows are estimated for the region. Values increase from about 90 mWm(-2) in the northern part of the study area to about 125 mWm(-2) in the southern part. These high heat flows are rather enigmatic because in the immediate vicinities of the sites there is little evidence of Cenozoic volcanism or syn-rift extensional tectonics. It is suggested that the geothermal anomaly in the southern Jornada del Muerto (approx. 125 to approx. 95 mWm(-2)

results from some type of mass movement-heat transfer mechanism operating in the crust just below the elastic layer. This conclusion is consistent with the geologic and geophysical data which describe a thin crust, apparently devoid of features indicative of extensional-tectonics in the upper part of the lastic crust.
Author

N86-31158*# Arizona Bureau of Geology and Mineral Technology, Tucson.
CENOZOIC EXTENSION AND MAGMATISM IN ARIZONA
S. J. Reynolds and J. E. Spencer *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 128 - 132 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

The Basin and Range Province of Arizona was the site of two episodes of Cenozoic extension that can be distinguished on the basis of timing, direction and style of extension, and associated magmatism. The first episode of extension occurred during Oligocene to mid-Miocene time and resulted in the formation of low-angle detachment faults, ductile shear zones (metamorphic core complexes), and regional domains of tilted fault blocks. Evidence for extreme middle Tertiary crustal extension in a NE to SW to SW to ENE to WSW direction has been recognized in various parts of the Basin and Range of Arizona, especially in the Lake Mead area and along the belf of metamorphic core complexes that crosses southern Arizona from Parker to Tucson. New geologic mapping and scrutiny of published geologic maps indicates that significant middle Tertiary extension is more widely distributed than previously thought. The state can be subdivided into regional tilt-block domains in which middle Tertiary rocks dip consistently in one direction. The dip direction in any tilt-block domain is generally toward the breakaway of a low-angle detachment fault that underlies the tilt-block domain; we interpret this an indicating that normal faults in the upper plate of a detechment fault are generally synthetic, rather than antithetic, with respect to the detachment fault.
Author

N86-31159*# California Univ., Los Angeles.
A NUMERICAL STUDY OF FORCED LITHOSPHERIC THINNING
G. Schubert, A. Anderson (Los Alamos National Lab., N. Mex.), and E. Fishbein *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 133 - 134 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

Subsolidus lithospheric thinning by mantle plumes may be involved in the creation of swells, hotspots, and rifts. Among the major questions concerning this process are the timescale on which it occurs and the structure of the plumes. The lithosphere is known to have been substantially thinned in 10 Ma or less. Current studies are focused on the lithospheric thinning by time-dependent plumes hypothesized to have large temperature differences across them.
Author

N86-31160*# Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
KINEMATICS OF A LARGE-SCALE INTRAPLATE EXTENDING LITHOSPHERE: THE BASIN-RANGE
Robert B. Smith and Paul K. Eddington *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 135 - 137 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

Upper lithospheric structure of the Cordilleran Basin Range (B-R) is characterised by an E-W symmetry of velocity layering. The crust is 25 km thick on its eastern active margin, thickening to 30 km within the central portion and thinning to approx. 25 km on the west. Pn velocities of 7.8 to 7.9 km/s characterize the upper mantle low velocity cushion, 7.4 km/s to 7.5 km/s, occurs at a depth of approx. 25 km in the eastern B-R and underlies the area of active extension. An upper-crustal low-velocity zone in the eastern B-R shows a marked P-wave velocity inversion of 7% at depths of 7 to 10 km also in the area of greatest extension. The seismic velocity models for this region of intraplate extension suggest major differences from that of a normal, thermally underformed continental lithosphere. Interpretations of seismic reflection data demonstrate the presence of extensive low-angle reflections in the upper-crust of the eastern B-R at depths from near-surface to 7 to 10 km. These reflections have been interpreted to represent low-angle normal fault detachments or reactivated thrusts. Seismic profiles across steeply-dipping normal faults in unconsolidated sediments show reflections from both planar to downward flatening (listric) faults that in most cases do not penetrate the low-angle detachments. These faults are interpreted as late Cenozoic and cataclastic mylonitic zones of shear displacement.
Author

N86-31161*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences
RIFT SYSTEMS ON VENUS: AN ASSESSMENT OF MECHANICAL AND THERMAL MODELS c91
Sean C. Solomon and James W. Head (Brown Univ., Providence, R. I.) *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 138 - 141 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

The formation and distribution of major tectonic features on Venus are closely linked to the dominant mechanism of lithospheric heat loss. Among the most spectacular and extensive of the major tectonic features on Venus are the Chasmata, deep linear valleys generally interpreted to be the products of lithospheric extension and rifting. Systems of chasmata and related features can be traced along several tectonic zones up to 20,000 km in linear extent. Mechanical and thermal models for terrestrial continental-rifting are applied to the rift systems of Venus. The models are tested against known topographic and tectonic characteristics of Venus chasmata as well as independent information on the physical properties of the Venus crust and lithosphere.
Author

N86-31162*# Arizona Bureau of Geology and Mineral Technology, Tucson.
POSSIBLE ROLE OF CRUSTAL FLEXURE IN THE INITIAL DETACHMENT OF EXTENSIONAL ALLOCHTHONS
Jon E. Spencer *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 142 - 144 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

The existence of low-angle normal faults indicates that the ratio of shear stress (TAU) to normal stress (sigma sub N) needed to cause slip on faults is substantially less than would be predicted based on experimental data. Because the tensional strength of rock at a large scale is exceedingly low, the upper plate of a low-angle normal fault cannot be pulled down the fault ramp, but must be driven down it by its own weight. The active or recently active Sevier Desert detachment fault in western Utah dips regionally at 12 deg. The radio of shear stress to normal stress due to the weight of the upper plate on a 12 deg dipping fault surface is 0.2. In contrast, laboratory experiments indicate that slip on fracture surfaces occurs with almost all rock types when (tau/sigma) reaches values of 0.6 to 0.85, corresponding to normal-fault dips of 30 deg to 40 deg. Seismological data indicate that low deviatoric stresses are associated with movement on faults of other geometrics and are not unique to low-angle normal faults. It thus appears that approximately planar fault zones with surface areas of hundreds to thousands of square kilometers have different mechanical properties than would be predicted based on laboratory studies of fractured rock. Modeling of stresses indicates that deviatoric stresses greater than 5kb exist and are sustainable in oceanic lithosphere, and that failure occurs when tau/sigma sub N approaches 0.6 to 0.85.
Author

N86-31163*# State Univ. of New York, Buffalo. Dept. of Geological Sciences.
THE EFFECTS OF STRAIN HEATING IN LITHOSPHERIC STRETCHING MODELS
Mike Stanton, Dennis Hodge, and Frank Cozzarelli *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 145 - 146 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

The deformation by stretching of a continental type lithosphere has been formulated so that the problem can be solved by a continuum mechanical approach. The deformation, stress state, and temperature distribution are constrained to satisfy the physical laws of conservation of mass, energy, momentum, and an experimentally defined rheological response. The conservation of energy equation including a term of strain energy dissipation is given. The continental lithosphere is assumed to have the rheology of an isotropic, incompressible, nonlinear viscous, two layered solid. Author

N86-31164*# Geological Survey, Menlo Park, Calif.
GEOMETRY OF MIOCENE EXTENSIONAL DEFORMATION, LOWER COLORADO RIVER REGION, SOUTHEASTERN CALIFORNIA AND SOUTHWESTERN ARIZONA: EVIDENCE FOR THE PRESENCE OF A REGIONAL LOW-ANGLE NORMAL FAULT
R. M. Tosdal and D. R. Sherrod *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 147 - 151 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

The geometry of Miocene extensional deformation, which changes along a 120 km-long, northeast-trending transect from the southestern Chocolate Mountains, southeastern California, to the Trigo and southern Dome Rock Mountains, southwestern Arizona is discussed. Based upon regional differences in the structural response to extension and estimated extensional strain, the transet can be divided into three northwesterly-trending structural domains. From southwest to northeast, these domains are: (1) southestern Chocolate-southernmost Trigo Mountains; (2) central to northern Trigo Mountains; and (3) Trigo Peaks-southern Dome Rock Mountains. All structures formed during the deformation are brittle in style; fault rocks are composed of gouge, cohesive gouge, and local microbreccia. In each structural domain, exposed lithologic units are composed of Mesozoic crystalline rocks unconformably overlain by Oligocene to Early Miocene volcanic and minor interbedded sedimentary rocks. Breccia, conglomerate, and sandstone deposited synchronously with regional extension locally overlie the volcanic rocks. Extensional deformation largely postdated the main phase of volcanic activity, but rare rhyolitic tuff and flows interbedded with the syndeformational clastic rocks suggest that deformation began during the waning stages of valcanism. K-Ar isotopic ages indicate that deformation occurred in Miocene time, between about 22 and m.y. ago. Author

N86-31165*# State Univ. of New York, Geneseo. Dept. of Geological Sciences.
SIMILARITIES AND CONTRASTS IN TECTONIC AND VOLCANIC STYLE AND HISTORY ALONG THE COLORADO PLATEAUS-TO-BASIN AND RANGE TRANSITION ZONE IN WESTERN ARIZONA: GEOLOGIC FRAMEWORK FOR TERTIARY EXTENSIONAL TECTONICS
R. A. Young, E. H. McKee, J. H. Hartman, and A. M. Simmons *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 152 - 155 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

The overall temporal and spatial relations between middle Tertiary volcanism and tectonism from the Basin and Range province onto the edge of the Colorado Plateaus province suggest that a single magnetic-tectonic episode affected the entire region more or less simultaneously during this period. The episode followed a post-Laramide (late Eocene through Oligocene) period of 25 million years of relative stability. Middle Tertiary volcanism did not migrate gradually eastward in a simple fashion onto the Colorado Plateau. In fact, late Oligocene volcanism appears to be more voluminous near the Aquarius Mountains than throughout the adjacent Basin and Range province westward to the Colorado River. Any model proposed to explain the cause of extension and detachment faulting in the eastern part of the Basin and Range province must consider that the onset of volcanism appears to have been approximately synchronous from the Colorado River region of the Basin and Range across the transition zone and onto the edge of the Colorado Plateaus. Author

N86-31166*# San Jose State Univ., Calif. Dept. of Meteorology.
AN ATLAS OF OBJECTIVELY ANALYZED ATMOSPHERIC CROSS SECTIONS, 1973-1980
Jindra Goodman, Steven E. Gaines, and R. Stephen Hipskind Sep. 1985 197 p
(Contract NCC2-73)
(NASA-CR-176937; NAS 1.26:176937) Avail: NTIS HC A09/MF A01 CSCL 04A

Atmospheric variability over time scales greater than one month is conceptually simplified and readily recognized from vertical cross-sections of zonal-monthly mean data. The reduction to two dimensions, latitude and height, explicitly eliminates all zonal waves but implicity retains their effects on the thermal-pressure fields and the dynamically related zonal wind fields. This atlas contains 96 examples, spanning all latitudes in both the northern and southern hemispheres and two decades in pressure, from 1000 to 10 mb. Four analyses, representing each month from January 1973 through December 1980, depicts the potential virtual temperature, the observed zonal wind velocity, the virtual temperature and the geostrophic zonal wind velocity. Each variable is contoured at a close interval to facilitate visual estimates of stability and vorticity via their gradients. The analyses are generated and contoured by objective computer methods from just one data source: in situ measurements from the conventional rawinradiosonde system. Although the analyses are independently made at constant pressure levels (the mandatory levels) the cross-sections are drawn with geopotential height as the ordinate. With this ordinate one can observe the seasonal expansion and contraction of the earth's atmosphere, especially that of the polar stratosphere. Also, the quasi-biannual cycle can be identified and studied directly from successive cross-sections. M.G.

N86-31167# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A STUDY OF ULTRAVIOLET EMISSIONS FROM THE OXIDES OF CARBON IN THE MESOSPHERE AND SHUTTLE ENVIRONMENT M.S. Thesis
Robert P. Tomic 1985 77 p
(AD-A166376; AFIT/CI/NR-86-4T) Avail: NTIS HC A05/MF A01 CSCL 04/1

This study seeks to determine if carbon oxide (CO, CO(+), CO2(+)) ultraviolet emissions in the mesosphere are observable, thus presenting an alternate method of determining the concentrations of these species. By developing photochemical models for CO(+) and CO2(+) it is shown that the concentration levels of CO(+) and CO2(+) are not adequate to produce UV band emissions bright enough to be detectable by spectrometric instruments. For CO, actual measurements of the concentrations were used in conjunction with g-factors to predict volume emission rates. These predictions indicate that only the CO fourth positive bands will be bright enough to measure by optical techniques. Mesospheric ultraviolet spectra obtained by the Imaging Spectrometeric Observatory (ISO) on the Spacelab 1 Mission are examined for the presence of the CO fourth positive bands and several bands are identified which are believed to be CO fourth positive. The CO fourth positive 1-6 band is used to calculate a density height profile for mesospheric CO. These calculations closely agree with measurements by others for mesospheric CO. This band system provides a viable method for measuring CO in the 80 km

to 110 km altitude region. A second study objective is to investigate whether carbon oxide emissions are found in the major products of shuttle engine exhaust and carbon materials are found to undergo significant mass loss on orbit. GRA

N86-31168# Aerodyne Research, Inc., Billerica, Mass.
A STUDY OF ATMOSPHERIC REACTIONS OF NEUTRAL SODIUM SPECIES AND OTHER METALS OF METEORIC ORIGIN Final Report, 10 Nov. 1982 - 9 Feb. 1986
J. A. Silver and C. E. Kolb 10 Feb. 1986 112 p
(Contract F19628-83-C-0010)
(AD-A166561; ARI-RR-508; AFGL-TR-86-0010) Avail: NTIS HC A06/MF A01 CSCL 04/1

The reactions of metallic species introduced into the atmosphere by meteor ablation may play a significant role in the chemistry of the lower thermosphere and upper stratosphere. The work described in this report summarizes a series of experimental rate constant measurements for reactions pertinent to these atmospheric regions. Prior to this work, virtually no direct kinetic parameters had been measured for the reactions of alkalis, and in particular sodium, which are believed to occur between 30 and 100 km in altitude. Model predictions of excited sodium emissions, expected concentration levels of the various alkali species, and the potential impact of alkali chemistry on the ozone balance all depended on theoretical estimates of reaction rate constants and product branching rations. Using a high temperature fast flow reactor and a variety of atomic and molecular species source and detection techniques, we have measured rate constants for over a dozen reactions. GRA

N86-31169# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
DETAILED GRAVITY ANOMALIES AND SEA SURFACE HEIGHTS DERIVED FROM GEOS-3/SEASAT ALTIMETER DATA
Richard H. Rapp Aug. 1985 134 p
(Contract F19628-82-K-0022)
(AD-A166593; OSU/DGSS-365; AFGL-TR-85-0191; SR-9) Avail: NTIS HC A07/MF A01 CSCL 08/5

Gravity anomalies and sea surface heights have been computed on a 0.125 deg grid in the ocean areas from a combined Geos-3/Seasat altimeter data set. The basic procedure used least squares collocation estimation where model covariance models were tailored to individual areas through altimeter residual variance scaling. Preliminary tests led to production prediction procedures using a reference model defined by a set of potential coefficients complete to degree 180. Comparisons of the predicted anomalies with ship derived values showed agreements varying from + or - 9 to + or - 30 mgals. No corrections to the altimeter implied sea surface heights were made for sea surface topography effects. The maximum anomaly predicted was 396 mgals near Hawaii and the most negative anomaly was -361 mgals over the Puerto Rican Trench. The 0.125 data set has been used to display the results using color plots, contour maps, and perspective views. The gridded data was used to compute 1 deg x 1 deg and 0.5 x 0.5 deg mean values. 1 deg mean anomalies were compared to terrestrial data where a difference of f + or - 7 mgals was found in comparing 10139 values. GRA

N86-31170# California Inst. of Tech., Pasadena. Seismological Lab.
INTERACTION OF SEISMIC WAVES WITH COMPLEX STRUCTURES Report, 12 Jan. 1984 - 11 Jan. 1985
Donald V. Helmberger, David G. Harkrider, and Robert W. Clayton 21 May 1985 52 p
(Contract F19628-83-K-0010)
(AD-A166715; AFGL-TR-85-0139; SR-2) Avail: NTIS HC A04/MF A01 CSCL 08/11

Recent models of earth structure suggest large horizontal gradients, especially in shear velocities. Some changes in existing methods are required to construct synthetics for broadband signals in many situations, especially when energy can reach the receiver by up-going as well as down going paths. This can be accomplished by allowing locally dipping structure and making some modifications to generalized ray theory. Local ray parameters are expressed in terms of a global reference which allows a de Hoop contour to be constructed for each generalized ray with the usual application of the Cagniard de Hoop technique. Synthetics generated from this method are compared with finite-difference runs using an advanced stable free surface boundary condition where lateral velocity and density variations at the free surface are treated properly. The method is implicit, but only requires a simple pentadiagonal system solver to implement. When coupled with second- and fourth order interior solutions, the overall problems appears to be stable for shear to compressional wave velocity greater than 0.01 and 0.02, respectively. The method is compared with other published algorithms for accuracy and stability. GRA

N86-31171# Utah State Univ., Logan.
INFRARED AIRGLOW CLUTTER Final Report, 15 Jul. 1983 - 30 Nov. 1985
J. Ulwick, K. Baker, and A. J. Steed Jan. 1986 46 p
(Contract F49620-83-C-0122)
(AD-A166994; AFOSR-86-0152TR) Avail: NTIS HC A03/MF A01 CSCL 04/1

A rocket and ground-based measurement programs was conducted to investigate infrared airglow and atomic oxygen density as part of the international MAP/WINE campaign in northern Scandinavia. The mean OH Meinel rotational temperature was approximately 199 K during a stratospheric warning event measured by a ground-based interferometer at ESRANGE in Sweden. This temperature is approximately 30 to 40 degress cooler than measurements taken when no stratospheric events were taking place and confirms the coupling theory that stratospheric warming results in mesospheric cooling. The atomic oxygen profiles measured by a rocket-borne resonance lamp technique showed a peak concentration of approximately 10 to the 11th power/cc between 90 and 100 km. The rocket results obtained between 90 and 180 km altitude show densities consistently almost an order of magnitude less than predicted by standard models. However, the rocket results are consistent with other measurements taken under similar conditions: winter nights with no particle precipitation. The 1.6 micrometer rocket-borne infrared radiometer also provided excellent altitude profiles of OH emissions. The STATE campaign examined some of the same phenomena with sounding rockets and in-situ probes launched from the Poker Flat Research Range, Alaska. GRA

N86-31172# Hebrew Univ., Jerusalem (Israel).
THE ORIENTATION DISTRIBUTION OF NONSPHERICAL AEROSOL PARTICLES WITHIN A CLOUD Final Report
Isaiah Gallily Dec. 1985 37 p
(Contract DAJA45-83-C-0004; DA Proj. 1T1-61102-BH-57)
(AD-A167326) Avail: NTIS HC A03/MF A01 CSCL 04/1

The orientation distribution of non-spherical particles within a cloud was studied. Theoretically, the subject was treated for a general laminar flow of immediate as well as weak and strong character, and for a turbulent flow whose Kolmogoroff scale was much larger than the particles themselves. The laminar flow served as one realization for the turbulent field within the cloud. It is found that the orientation distribution function in a laminar medium is generally structured with a preferred orientation while that of the turbulent medium is random on the average but with a significant dispersion. Experimentally, a horizontal wind tunnel was erected for orientation measurements; it was equipped with a dedicated hot-wire computerized system for turbulence characterization, which was shown to conform to the determinations of Laufer. Light scattering signals were used as the orientation-gauge. GRA

N86-31173# Los Alamos National Lab., N. Mex.
EVALUATION OF THE TOTAL MAGNETOSPHERIC ENERGY OUTPUT PARAMETER, U/SUB T/
R. D. Zwickl, L. F. Bargatze, D. N. Baker, C. R. Clauer, and R. L. McPherron 1985 18 p Presented at the Chapman Conference on Magnetotail Physics, Laurel, Md., 28 Oct. 1985 Prepared in cooperation with Stanford Univ., Calif. and California Univ., Los

Angeles
(Contract W-7405-eng-36)
(DE86-006017; LA-UR-86-166; CONF-8510254-4) Avail: NTIS HC A02/MF A01

Over the last few years the relationship between U(sub T), the magnetospheric energy consumption or output rate, and epsilon, a commonly used solar wind-magnetosphere energy input function, has been explored in some detail. Very high correlations between U(sub T) and epsilon are found during periods of strong activity, and by using linear prediction filtering techniques a delta-function impulse response was found for filter elements representing essentially zero delay. In light of these remarkable results, the derivation of U(sub T) for these intervals is re-examined. We find that U(sub T) is dominated in each event interval by the term containing tau(sub R), the ring current decay time, and that when tau(sub R) is defined as a function of epsilon the delta-function impulse response is present. If a constant tau(sub R) is assumed, the delta-function part of the filter disappears completely. Thus, this delta-function, which has been taken as being indicative of the directly driven component is an artifact of the earlier analysis, and it is due to the dependence of U(sub T) on epsilon. Our results imply that until U(sub T) can be derived independently from epsilon, these two quantities cannot be compared in a meaningful way, and that results obtained in previous studies are not valid. DOE

N86-31174# Geological Survey, Denver, Colo.
TOPOGRAPHY, STRESSES, AND STABILITY AT YUCCA MOUNTAIN, NEVADA
H. S. Swolfs and W. Z. Savage 1985 11 p Presented at the 26th US Symposium on Rock Mechan ics, Rapid City, S.D., 26 Jun. 1985
(Contract DE-AI08-78ET-44802)
(DE86-008247; CONF-850671-21) Avail: NTIS HC A02/MF A01

Plane-strain solutions are used to analyze the influence of topography on the state of stress at Yucca Mountain, Nye County, Nevada. The results are in good agreement with the measured stress components obtained in drill holes by the hydraulic-fracturing technique, particularly those measured directly beneath the crest of the ridge, and indicate that these stresses are gravitationally induced. A separate analysis takes advantage of the fact that a well-developed set of vertical faults and fractures, subparallel to the ridge trend, imparts a vertical transverse isotropy to the rock and that, as a consequence of gravitational loading, unequal horizontal stresses are induced in directions perpendicular and parallel to the anisotropy. DOE

N86-31175# Brookhaven National Lab., Upton, N. Y.
CHEMICAL INSTRUMENTATION FOR FIELD STUDIES OF ATMOSPHERIC WET DEPOSITION PROCESSES
R. L. Tanner Nov. 1985 8 p Presented at the 191st American Chemical Society National Meeting, New York, N.Y., 13 Apr. 1986
(Contract DE-AC02-76CH-00016)
(DE86-005255; BNL-37346; CONF-860425-10) Avail: NTIS HC A02/MF A01

Field studies of wet deposition processes require the differentiation and determination of many trace reactive species in the atmosphere. These species may be present in clear-air gaseous or aerosol phases, or they may be distributed between cloudwater or precipitation and interstitial gaseous phases. Analytical requirements on existing techniques have been extremely rigorous and, in several cases, have required development of new approaches to the sampling and determination of critical species. This paper reviews these developments with respect to airborne sampling in all general areas. DOE

N86-31176# Los Alamos National Lab., N. Mex.
BISTATIC PHASE SOUNDING IN THE IONOSPHERE ABOVE THE MINOR SCALE EXPLOSION
Joseph Fitzgerald Feb. 1986 27 p
(Contract W-7405-eng-36)
(DE86-008582; LA-10657-MS) Avail: NTIS HC A03/MF A01

A 4.8-kT chemical explosion named Minor Scale was detonated at the White Sands Missile Range on June 26, 1985. Following the detonation, three bistatic HF phase sounders observed disturbances in the ionosphere directly over the explosion. The path from transmitters to receivers, which were 283 km apart, had a midpoint 7 km northeast of ground zero. We describe the experiment and present time histories of the power spectra of the three transmission. Between 300 and 360 s after the explosion, all three links showed changes in spectra. The lowest frequency shifted by -1 Hz, indicating the passage of the acoustic wave from the explosion through the total reflection height in the E-layer at about 95 km. We model the Doppler shift and absorption change to be expected for this disturbance assuming the acoustic wave had an N-wave profile with a maximum amplitude of 15%. The spectra of the lowest frequency also show temporary peaks at negative Doppler that indicate partial reflection modes from upper and lower edges of the N-wave. We calculate the Doppler shift and reflection coefficients for these partial reflection modes. During the same time period, the spectra of the two higher frequency transmissions also showed temporary peaks at negative Doppler that rapidly changed their frequency offset. DOE

N86-31177# Argonne National Lab., Ill.
DEWITT FIELD STUDY: SURFACE FLUX OBSERVATIONS, IN SITU SOUNDINGS AND REMOTE SENSING OF CONDITIONS AFFECTING THE BEHAVIOR OF THE MIXED LAYER OVER LAND
R. L. Coulter, M. L. Wesely, D. L. Sisterson, T. J. Martin, R. L. Hart, D. R. Cook, P. E. Hess, E. W. Eloranta, and B. B. Hicks Mar. 1986 175 p
(Contract W-31-109-eng-38)
(DE86-008942; ANL/ER-85-1) Avail: NTIS HC A08/MF A01

The DeWitt field study, conducted July 10 to 21, 1979, provides information on the structure of the lower 2 km of the atmosphere and the surface boundary conditions for flat farmland in central Illinois. Mean wind and temperature profiles in the lower atmosphere were measured by in-situ soundings both with high-resolution miniature radiosondes and an instrument package carried aloft by a kytoon. The height and depth of the entrainment zone at the top of the boundary layer, and some wind velocity component means and turbulence statistics were measured with lidar and solar remote sensing systems. Standard meteorological surface observations, measurements of solar and net radiation, and eddy fluxes of momentum, heat, water vapor, and ozone over a local maize canopy complete the body of data collected. This report summarizes methods of observation and data reduction and presents the processed data in tabular and graphic forms in a series of appendices. These results can be used to test models of planetary boundary layer behavior, including the influences of surface fluxes and entrainment aloft on the variation of mixed layer heights and mixing processes in the boundary layer. DOE

N86-31178# Kiruna Geophysical Inst. (Sweden).
DETERMINATION OF THE THERMOSPHERIC NEUTRAL WIND FROM INCOHERENT SCATTER RADAR MEASUREMENTS
I. Haeggstroem, J. Murdin, and D. Rees (University Coll., London (England).) Nov. 1984 27 p Original document contains color illustrations
(KGI-186; ISSN-0347-6405; ESA-86-97225) Avail: NTIS HC A03/MF A01

Measurements made by the EISCAT UHF incoherent scatter radar were used to derive thermospheric winds, which were compared to Fabry-Perot interferometer measurements of the neutral wind made simultaneously. Lack of knowledge of the vertical component of the neutral wind (assumed to be zero) and the neutral gas temperature (MSIS model values assumed) produces large uncertainties in the radar neutral wind. A Fabry-Perot interferometer observing vertically upwards through the radar scattering volume would produce estimates of the vertical component of the neutral wind and neutral temperature, however, with uncertainty in the altitude of the measurements. ESA

N86-31179# Uppsala Ionospheric Observatory (Sweden).
[ACTIVITIES REPORT OF THE IONOSPHERIC OBSERVATORY]

Annual Report, 1985
1986 52 p
(UIO-SR-86-01; ISSN-0349-2699; ESA-86-97227) Avail: NTIS HC A04/MF A01

Research in high latitude ionospheric phenomena and phenomena related to the interaction of the ionosphere with the magnetosphere and with the neutral atmosphere is summarized. In situ experiments with sounding rockets and the Swedish Viking satellite are described. Ground-based, remote sensing experiments use radar and radio techniques, in particular EISCAT, backscatter radars, and equipment for observing stimulated electromagnetic emissions from heating experiments. Routine monitoring of ionospheric conditions is performed using the ionosonde, riometer, and backscatter radar techniques. ESA

N86-31180# National Bureau of Standards, Gaithersburg, Md. National Engineering Lab.
SKY LUMINANCE AND DIRECT BEAM ILLUMINANCE
S. J. Treado, W. E. Remmert, and J. W. Bean Mar. 1986 51 p
(PB86-196755; NBSIR-85/3251) Avail: NTIS HC A04/MF A01 CSCL 13A

Measurement of sky illuminance, sky luminance, direct beam illuminance and direct beam irradiance are analyzed and discussed. The database consisted of an annual set of integrated hourly measurements made at the National Bureau of Standards, Gaithersburg, Maryland. The relationship between diffuse sky illuminance and luminance of selected portions of the sky dome is examined. Measured sky luminances are compared to luminance calculated using equations for three standard sky types - clear, partly cloudy and overcast. The results indicate that the luminance distribution of actual skies varies considerably from the standard skies. GRA

N86-31181*# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 497, JANUARY 1986. PART 1: (PROMPT REPORTS). DATE FOR DECEMBER 1985, NOVEMBER 1985 AND LATE DATA
H. E. Coffey Jan. 1986 95 p
(Contract NASA Order-W-15519; Grant NSF ATM-83-18491)
(NASA-CR-177170; NAS 1.26:177170; PB86-168630;
SGD-497-Pt-1) Avail: NTIS HC A05/MF A01 CSCL 03B

Solar-Geophysical Data Number 497, January 1986, Part 1 (prompt reports); Data for December 1985, November 1985 and Late Data contains the Data for December 1985-(IUWDS alert periods (advance and worldwide), solar activity indices, Solar flares, Vostok inferred interplanetary magnetic field polarity, Stanford mean solar magnetic field); data for November 1985-(solar active regions, sudden ionospheric disturbances, solar radio spectral observations, cosmic ray measurements by neutron monitor, geomagnetic indices, radio propagation indices); and late data-(geomagnetic indices, calcium plage data). GRA

N86-31182*# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 497, JANUARY 1986. PART 2: (COMPREHENSIVE REPORTS). DATA FOR JULY 1985, AND MISCELLANEA
H. E. Coffey Jan. 1986 47 p
(Contract NASA Order-W-15519; Grant NSF ATM-83-18491)
(NASA-CR-177169; NAS 1.26:177169; PB86-168648;
SGD-497-Pt-2) Avail: NTIS HC A03/MF A01 CSCL 03B

Solar-Geophysical Data Number 497, January 1986. Part 2: (Comprehensive Reports); Data for July 1985, and Miscellanea contains the following: a detailed index for 1985; data for July 1985-(solar flares, solar radio bursts at fixed frequencies, solar x-ray radiation from GOES satellite, mass ejections from the sun, active prominences and filaments); and miscellaneous data-(Meudon carte synoptique 16 April - 13 May 1985, number of solar flares August 1966 - July 1985). GRA

N86-31088# Technische Univ., Clausthal-Zellerfeld (West Germany). Inst. fuer Geologie und Palaeontologie.
GEOLOGY
P. Kronberg and P. Murino (Naples Univ., Italy) *In* DFVLR The X-SAR Science Plan Nov. 1985 p 43-74 (For primary document see N86-31084 22-42)
Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N86-31183*# New York Univ., New York. Dept. of Applied Science.
APPLICATION OF SOLAR MAX ACRIM DATA TO ANALYZE SOLAR-DRIVEN CLIMATIC VARIABILITY ON EARTH Final Report, 1 Feb. 1985 - 31 Jan. 1986
Martin I. Hoffert Sep. 1986 20 p
(Grant NAG5-503)
(NASA-CR-176855; NAS 1.26:176855; NYU/DAS-86-151) Avail: NTIS HC A02/MF A01 CSCL 04B

Terrestrial climatic effects associated with solar variability have been proposed for at least a century, but could not be assessed quantitatively owing to observational uncertainities in solar flux variations. Measurements from 1980 to 1984 by the Active Cavity Radiometer Irradiance Monitor (ACRIM), capable of resolving fluctuations above the sensible atmosphere less than 0.1% of the solar constant, permit direct albeit preliminary assessments of solar forcing effects on global temperatures during this period. The global temperature response to ACRIM-measured fluctuations was computed from 1980 to 1985 using the NYU transient climate model including thermal inertia effects of the world ocean; and compared the results with observations of recent temperature trends. Monthly mean ACRIM-driven global surface temperature fluctuations computed with the climate model are an order of magnitude smaller, of order 0.01 C. In constrast, global mean surface temperature observations indicate an approx. 0.1 C increase during this period. Solar variability is therefore likely to have been a minor factor in global climate change during this period compared with variations in atmospheric albedo, greenhouse gases and internal self-inducedoscillations. It was not possible to extend the applicability of the measured flux variations to longer periods since a possible correlation of luminosity with solar annual activity is not supported by statistical analysis. The continuous monitoring of solar flux by satellite-based instruments over timescales of 20 years or more comparable to timescales for thermal relaxation of the oceans and of the solar cycle itself is needed to resolve the question of long-term solar variation effects on climate. Author

N86-31184# Air Force Geophysics Lab., Hanscom AFB, Mass.
METEOROLOGICAL MEASUREMENTS ON LINE-OF-SIGHT MICROWAVE RADIO LINKS: ENVIRONMENTAL RESEARCH PAPERS, 1983 - 1985
James F. Morrissey, Yutaka Izumi, and Owen Cote 22 Nov. 1985 66 p
(AD-A166627; AFGL-TR-85-0299; AFGL-ERP-935) Avail: NTIS HC A04/MF A01 CSCL 17/2

Meteorological measurements on two experimental microwave radio links in New England are presented. The links were from Pack Monadnock in N.H. to Prospect Hill in Waltham, Mass., in 1983, and from Saddleback Mountain in N.H. to Prospect Hill in 1984. These data are then used in ray-trace programs to determine multipath delays and variations in the angle of arrival at the receiver. Several cases of low-level ducts due to inversions caused by radiational cooling are analyzed. GRA

N86-31185# Air Force Geophysics Lab., Hanscom AFB, Mass.
A CANDIDATE MESOSCALE NUMERICAL CLOUD/PRECIPITATION MODEL: ENVIRONMENTAL RESEARCH PAPERS, SEP. 1984 - SEP. 1985
Daniel Ridge, George Modica, and Arthur Jackson 10 Oct. 1985 30 p
(AD-A166628; AFGL-TR-85-0252; AFGL-ERP-931) Avail: NTIS HC A03/MF A01 CSCL 04/2

A numerical mesoscale forecast model was selected for potential use by the Air Force in an operational mode, either in a nested configuration, or as a stand-alone model in a base-weather station. The model was developed at the National Oceanographic and Atmospheric Association's (NOAA) Environmental Research Laboratory (ERL), and many of its numerical and meteorological features are described in this report. Two versions are specified: the first under development at NOAA/ERL and another at AFGL (the NOAA/AFGL model). A baseline test of the latter model revealed several problems. The initialization scheme computed initial fields of mass and momentum that failed to mutually adjust after several hours of integration. Subsequent techniques designed to improve the initial conditions appeared to be a step in the right direction. The nonmeteorological gravity-inertia wave noise evident in most of the forecast fields appeared to result from poor treatment of the variables at the lateral boundaries. Author (GRA)

N86-31186# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
THE EFFECT OF SMOOTHING THE DOPPLER RADAR DERIVED WIND FIELD ON PERTURBATION PRESSURE RETRIEVAL M.S. Thesis
George Philip Rosser, Jr. May 1986 53 p
(AD-A166631; AFIT/CI/NR-86-31T) Avail: NTIS HC A04/MF A01 CSCL 04/2

Gridded u and v wind components derived from dual-Doppler radar data were utilized to study the behavior of the perturbation pressure field when different amounts of smoothing were applied to the wind field. Data-void areas in the wind field were filled by extrapolation. Three-point and nine-point smoothing operators were employed to smooth the wind field prior to retrieving the perturbation pressure field. Smoothing the wind field produced a nonlinear variation of the central pressure value in a meso-low with respect to the smoothing parameter. The central pressure value decreased as the smoothing parameter increased. Pressure centers less than 0.1 kPa (1 mb) in absolute magnitude tended to amplify and migrate slightly. False pressure centers created by the data-void filling technique were removed when a smoothing parameter greater than or equal to 0.4 was employed. Smoothing parameters greater than or equal to 0.5 created a false pressure center.Author (GRA)

N86-31187# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
METEOROLOGICAL TELECONNECTIONS BETWEEN THE SAHEL AND THE EASTERN UNITED STATES M.S. Thesis
Jeffrey Earl Malan Dec. 1985 69 p
(AD-A166632; AFIT/CI/NR-86-32T) Avail: NTIS HC A04/MF A01 CSCL 04/2

The existence of atmospheric teleconnections between the Sahel and the eastern United States is investigated on a seasonal time scale. Precipitation data for the Sahel and surface temperature data for the eastern United States from the years 1951 through 1977 in the months June through October are used. The statistical procedures applied are principal component analysis; Pearson's product-moment and Spearman's rank correlation, simple linear regression. Data of the 700 mb height data are used to produce composite charts of seasonal circulation and for conducting circulation analysis in an effort to associate climate signals with anomalous conditions of the general circulation. Two readily identifiable modes of large-scale spatial variability are found in the first and second principal components. The first indicates the existence of an inverse relationship between precipitation in the Sahel and surface temperature in the eastern United States. The second principal component indicates a direct relationship between these two regimes. Circulation analyses reveal patterns in the 700 mb height anomaly field which may be connected with the postulated inverse relationship. Author (GRA)

N86-31188# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
TYPHOON STRUCTURAL VARIABILITY Thesis
Candis L. Weatherford Oct. 1985 94 p
(Grant NSF ATM-84-19116)
(AD-A166772; AFIT/CR/NR-86-10T) Avail: NTIS HC A05/MF A01 CSCL 04/2

This paper describes the varying structure of the tropical cyclone wind profile in terms of its core intensity, outer strength, and size where core intensity is defined by the tropical cyclone's minimum central sea-level pressure. Outer strength is an average tangential wind speed from 60 to 150 b nu (111-278 km), and size measures the radial extent of 30-kt and 50-kt surface winds. Analysis was performed on 700 mb aircraft data from over 500 reconnaissance mission into 66 Tropical cyclones of the northwestern Pacific. All these cyclones were of typhoon intensity sometime during their lifecycle. This data set is uniquely suited to fill the dual needs of: 1) providing inner wind profile information out to 4 deg radius, thus allowing the cyclone's strength to be measured; and 2) being able to sample the entire life cycle of the tropical cyclone from depression through supertyphoon stages. The focus of this study is on the outer strength region. GRA

N86-31189# Army Electronics Research and Development Command, White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
THE US ARMY YUMA PROVING GROUND, ARIZONA 22-YEAR CLIMATE CALENDAR 1954-1975 Final Technical Report
James C. Devine Mar. 1986 64 p
(AD-A166878; AD-E440321; ERADCOM/ASL-TR-0200) Avail: NTIS HC A04/MF A01 CSCL 04/2

This report contains, in calendar form, the following data for the Yuma Proving Ground, AZ: average daily maximum and minimum temperatures, record extremes of these parameters, and year of occurrences; monthly average maximum and minimum temperatures, and average relative humidity; average windspeed in knots; prevailing wind direction; average and maximum precipitation values daily and by month; average sky cover and average number of days clear, partly cloudy, and cloudy. Tables covering data of interest include: maximum and minimum temperatures, to include total occurrences and percentage of overall occurrence as well as monthly percentages of occurrence; seasonal maximum, minimum, and daily average temperatures; precipitation by monthly occurrence and monthly and annual totals; sky condition; relative humidity; soil temperatures; station atmospheric pressure; degree days both heating and cooling; and sunrise-sunset tables. The general terrain features, climate, trafficability, thunderstorms, and periods of special weather interest are covered in the text and appendix A. GRA

N86-31190# Oak Ridge National Lab., Tenn.
HIERARCHY THEORY AND GLOBAL CHANGE
R. V. ONeill 1985 27 p Presented at the Workshop on Global Change, St. Petersburg, Fla., 28 Oct. 1985
(Contract DE-AC05-84OR-21400)
(DE86-005154; CONF-8510284-1) Avail: NTIS HC A03/MF A01

Hierarchy theory asserts that a useful way in which to deal with complex, multiscaled systems is to focus on a single phenomenon and a single time-space scale. By so limiting the problem, it is possible to define it clearly and choose the proper system to emphasize. This paper applies the theory to the problem of global change. DOE

N86-31191# Lawrence Livermore National Lab., Calif.
RESULTS OF COMPARISON STUDIES OF INFRARED RADIATIVE TRANSFER MODELS
F. M. Luther Feb. 1986 11 p Presented at the 6th Conference on Atmospheric Radiation, Williamsburg, Va., 12 May 1986
(Contract W-7405-eng-48)
(DE86-006531; UCRL-93488; CONF-860562-1) Avail: NTIS HC A02/MF A01

The capability to accurately model the natural and perturbed climate is important to the understanding of current-related issues. It is important that all the major physical processes and feedback mechanisms in climate models be evaluated as to their accuracy and limitations. Since the transfer of solar and longwave radiation represents the prime physical process that drives the circulation of the atmosphere and its temperature structure, an evaluation of the modeling of radiative processes is a critical element in the overall evaluation of the models. This paper discusses model comparison studies of infrared radiative transfer models that have

been conducted for the purpose of validating and improving these models. DOE

N86-31192# Australian Atomic Energy Commission, Lucas Heights.
SOME ATMOSPHERIC DISPERSION, WIND AND TEMPERATURE STATISTICS FROM JERVIS BAY, AUSTRALIAN CAPITAL TERRITORY 1972 TO 1974
G. H. Clark Jul. 1985 23 p
(DE86-701370; AAEC/E-606) Avail: NTIS (US Sales Only) HC A02/MF A01

A meteorological study of winds, temperatures and Pasquill stability categories was conducted in the coastal conditions at Jervis Bay. Three Pasquill stability categorisation schemes were compared. These indicated a predominance of neutral to slightly unstable conditions. During the daytime, north bay breezes and north-east sea breezes were most common together with on-shore south-east winds. Off-shore south-west winds prevailed during winter and were observed most frequently at night. DOE

N86-31193# International Centre for Theoretical Physics, Trieste (Italy).
PARAMETERS DETERMINING MAXIMUM WIND VELOCITY IN A TROPICAL CYCLONE
A. M. Choudhury Sep. 1984 11 p Submitted for publication Sponsored by IAEA and UNESCO
(DE86-701371; IC-84/159) Avail: (US Sales Only) NTIS HC A02/MF A01

The spiral structure of a tropical cyclone was earlier explained by a tangential velocity distribution which varies inversely as the distance from the cyclone centre outside the circle of maximum wind speed. The case has been extended in the present paper by adding a radial velocity. It has been found that a suitable combination of radial and tangential velocities can account for the spiral structure of a cyclone. This enables parametrization of the cyclone. Finally a formula has been derived relating maximum velocity in a tropical cyclone with angular momentum, radius of maximum wind speed and the spiral angle. The shapes of the spirals have been computed for various spiral angles. DOE

N86-31194# Oregon State Univ., Corvallis. Wind Resources Assessment Lab.
PACIFIC NORTHWEST WIND REGIONAL ENERGY ASSESSMENT PROGRAM, VOLUME 1 Final Report
R. W. Baker, J. E. Wade, W. Frick, R. Wittrup, and J. Buckley Oct. 1985 163 p
(Contract DE-AC79-81BP-25593)
(DE86-007113; DOE/BP-25593/1-Vol-1; BPA-85-19-Vol-1) Avail: NTIS HC A08/MF A01

In 1980 BPA began a 5-year Wind Regional Energy Assessment Program (WIND REAP) to assess the wind resource potential throughout the BPA service area. Areas showing evidence of high wind potential were identified and instrumented with anemometers. The wind data indicate that there is a very diverse wind flow over the region as the wind strength varies considerably both on a daily and seasonal basis. Some areas indicate strong winter winds, while others recorded the strongest winds in the spring and/or summer. Wind data were analyzed for 300 sites, and it was found that there are 39 areas that have wind energy development potential. The intermittent but diverse energy resource is available during most seasons. However, there are a few major development obstacles such as transmission network strength and land-use constraints that may limit or prevent the implementation of some of this resource. DOE

N86-31195# National Severe Storms Forecast Center, Kansas City, Mo.
SEVERE LOCAL STORM WARNING VERIFICATION PRELIMINARY PROCEDURES
Leo A. Grenier and John T. Halmstead Apr. 1986 18 p
(PB86-194362; NOAA-TM-NWS-NSSFC-12) Avail: NTIS HC A02/MF A01 CSCL 04B

Verification of severe local storm warnings issues by National Weather Service offices is performed at the National Severe Storms Forecast Center (NSSFC). Issued warnings and event reports are collected and processed prior to verification. As part of these preliminary procedures two products are routinely disseminated nationally via the AFOS network. A summary of severe local storm event reports received during the previous 24 hours (CCCSTADTS) is prepared daily. Once each week, a summary (CCCSTAXXX) is prepared for each WSFO. The summary lists events and warnings processed during the previous week for all stations within the management area of that WSFO. A thorough knowledge of preliminary verification procedures and routine use of these products, as presented in the report, can insure greater accuracy of data and aid the WSFO in the preparation of Storm Data and Unusual Weather Phenomena (Form F-8). GRA

N86-31196# National Center for Atmospheric Research, Boulder, Colo. Atmospheric Analysis and Prediction Div.
INTRODUCTION TO THE CCM MODULAR PROCESSOR (VERSION PROCO1)
Michael A. Dias Jan. 1986 54 p
(Grant NSF ATM-82-17015)
(PB86-188679; NCAR/TN-262-IA) Avail: NTIS HC A04/MF A01 CSCL 04B

The technical note provides an introduction to the CCM Modular Processor, a post-processing software package for the analysis of data on history tapes (mass storage volumes) output by the NCAR Community Climate Model (CCM). The document is designed as a tutorial to teach new users how to access the processor and complete simple tasks, and as a quick reference guide for more experienced users. The introduction/tutorial is not a comprehensive description of the modular processor. GRA

N86-31197# National Center for Atmospheric Research, Boulder, Colo. Atmospheric Analysis and Prediction Div.
CCM MODULAR PROCESSOR USERS' GUIDE (VERSION PROCO1)
Richard J. Wolski Jan. 1986 172 p
(Grant NSF ATM-82-17015)
(PB86-187069; NCAR/TN-261-IA) Avail: NTIS HC A08/MF A01 CSCL 04B

The NCAR CCM Modular Processor is the primary tool for the analysis of data output by the NCAR Community Climate Model. The User's Guide contains complete instructions for running the PROCO1 version of the Processor on the Crays at NCAR, and replaces Part 1 of the previous Users' Guide (NCAR/TN-216+IA), August 1983). Operations available in the PROCO1 version include the computation of spatial and time averages (plus related statistics), vertical interpolation to pressure surfaces, horizontal interpolation and filtering in spectral space, time filtering, comparison of different Model Case, and the computation of new quantities (derived fields) based on those output by the Model. Output from the Processor may take the form of printed values, binary data for subsequent analysis by the Processor or other programs, and a wide variety of graphics. Data may be plotted as (1) field-value curves, two-dimensional contours, or vector arrows, all on several spatial projections; (2) time series curves or contours; and (3) curves of spectral coefficients. GRA

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

N86-31198*# National Aeronautics and Space Administration, Washington, D.C.
NASA OCEANIC PROCESSES PROGRAM Annual Report, fiscal year 1985
Aug. 1986 162 p
(NASA-TM-88987; NAS 1.15:88987) Avail: NTIS HC A08/MF A01 CSCL 08C

This, the Sixth Annual Report for NASA's Oceanic Processes

Program, provides an overview of recent accomplishments, present activities, and future plans. Although the report was prepared for Fiscal Year 1985 (October 1, 1984 to September 30, 1985), the period covered by the Introduction extends into June 1986. Sections following the Introduction provide summaries of current flight projects and definition studies, brief descriptions of individual research activities, and a bibliography of refereed journal articles appearing within the past two years. Author

N86-31199# Naval Research Lab., Washington, D. C.
INTERACTIONS BETWEEN OCEAN SURFACE WAVES AND CURRENTS Memorandum Report, Sep. 1984 - Aug. 1985
A. L. Cooper 2 Apr. 1986 21 p
(AD-A166688; NRL-MR-5755) Avail: NTIS HC A02/MF A01 CSCL 20/4

A mathematical model is developed to describe the interaction between random ocean surface waves and the wake produced by a surface ship. Calculations are presented for the mean square free surface displacement energy for the short wave length components of the wave field and its modification due to refraction by the surface wake. It is demonstrated that a significant reduction of the short wavelength contribution to the surface energy can result from this interaction. A procedure to calculate the spectral composition of the free surface and the spatial realization of the free surface displacement is outlined. Free surface realizations will be presented in a forthcoming report. GRA

N86-31200# Army Engineer District, Los Angeles, Calif. Coastal Resources Branch.
COAST OF CALIFORNIA STORM AND TIDAL WAVES STUDY: SOUTHERN CALIFORNIA COASTAL PROCESSES DATA SUMMARY
Douglas L. Inman, Robert T. Guza, David W. Skelly, and Thomas E. White Feb. 1986 580 p
(AD-A166699; CCSTWS-86-1) Avail: NTIS HC A25/MF A01 CSCL 08/3

The intent of this report is to provide a broad picture of the physical, mechanical and geological processes pertaining to coastal engineering along the shorelines of southern California, and to give references to data sources. Citation to the originators of concepts, theories, etc. are not always given because this is a data summary for the region, not a review of the nearshore processes literature. Interested readers should consult the extensive coastal engineering and nearshore processes literature for a historical perspective of the topics discussed. Because of space constraints, some topics are only scantily covered. Chapters 1 and 2 and portions of the following chapters were written by Douglas L. Inman. Chapter 3 and the sections on neashore waves and currents for each cell described in Chapters 4 through 11 were written by Robert T. Guza. For Chapters 4 through 11 the sections on coastal erosion, shoreline changes, sediment sources and the budget of sediment were written by David W. Skelly; while the sections on sediment transport modes and sediment sinks were written by Thomas E. White. Unpublished notes provided by Dr. Reinhard Flick were used for the preparation of Chapter 3.4 on tides and sea level fluctuations. GRA

N86-31201# Army Engineer District, Los Angeles, Calif. Coastal Resources Branch.
COAST OF CALIFORNIA STORM AND TIDAL WAVES STUDY. SHORELINE MOVEMENT DATA REPORT: PORTUGUESE POINT TO MEXICAN BORDER (1852-1982)
Paul F. May and Brian M. Baldwin Dec. 1985 172 p
(AD-A166749; CCSTWS-85-10) Avail: NTIS HC A08/MF A01 CSCL 08/6

This report describes the results of a cooperative study of shoreline movement conducted as part of the Coast of California Storm and Tidal Waves Study (CCSTWS). The study area comprised the Pacific Ocean coast from Portuguese Point. CA, (Near Los Angeles) south to the United States/Mexico Border, a distance of approximately 125 miles. Changes in shoreline position ranging from as early as 1852 or as late as 1959, up to 1982, are analyzed using survey data from NOAA's National Ocean Service (NOS) and its predecessor, the U.S. Coast and Geodetic Survey. A series of shoreline movement maps for this coastal reach produced by NOS is intended to accompany this report. This report provides a basic data set for use in management and engineering decisions related to the coastal zone. It is designed primarily to describe and partially quantify shoreline movement maps that accompany it. Average yearly land area and shoreline movement rates of change were calculated for each minute of longitude for the area from Portuguese Point south to Anaheim Bay (east-west-trending shoreline), and for each minute of latitude from Anaheim Bay to the U.S./Mexico border (north-south trending shoreline). The sole purpose of this report is to describe and quantify historic shoreline movement. No attempts were made to identify or even speculate on the reasons for these movements. GRA

N86-31202# Army Engineer District, Los Angeles, Calif. Coastal Resources Branch.
COAST OF CALIFORNIA STORM AND TIDAL WAVES STUDY: SOUTHERN CALIFORNIA COASTAL PHOTOGRAPHY AND BEACH PROFILE INDEX
Feb. 1986 140 p
(AD-A166780; CCSTWS-86-2) Avail: NTIS HC A07/MF A01 CSCL 08/6

The purpose of this report is to compile an inventory of the aerial photography, ground photos and beach profile data long the Coast of California that are available in the U.S. Army Corps of Engineers, Los Angeles District (LAD; also includes other Federal, State, and local governmental agencies). These photographs and beach profiles were compiled to document dimensions and beach characteristics, historic shoreline changes, effects of storms and structures on the beach, and any significant beach and inlet changes. The information described in this report is available for use and inspection by Government agencies, educational institutions, coastal engineers and other coastal interest groups. GRA

N86-31203# Army Engineer District, Los Angeles, Calif. Coastal Resources Branch.
COAST OF CALIFORNIA STORM AND TIDAL WAVES STUDY. HYDRAULIC DATA INVENTORY: SOUTHERN CALIFORNIA COASTAL ZONE
Dec. 1985 39 p
(AD-A166781; CCSTWS-85-9) Avail: NTIS HC A03/MF A01 CSCL 08/8

This report is a literature review and data summary covering the topics of river sediment discharge, lagoon storage, streambed sediment, and wind transport. This literature review and data summary are limited to California coastal rivers/streams between Ragged Point (San Luis Obispo County) and the Mexican border and are limited to literature containing measurements or quantitative estimates pertaining to the above topics. A summary of results is as follows. Twenty-three references were located which contain quantitative information on river sediment discharge. Practically no quantitative information on lagoon sediment storage for Southern California was located during this review. Seven references were located which contain results of sediment gradation tests of streambed samples. These references give data for 11 Southern California streams. No quantitive information on wind transport of sediment was located for the Southern California Coast. Some information concerning coastal sand dune locations in one reference and some concerning wind direction in another reference may be useful for estimating wind transport in future analyses. GRA

N86-31204# Army Engineer District, Los Angeles, Calif. Coastal Resources Branch.
COAST OF CALIFORNIA STORM AND TIDAL WAVES STUDY. HYDRAULIC DATA INVENTORY: SOUTHERN CALIFORNIA COASTAL ZONE
Dec. 1985 282 p
(AD-A166782; CCSTWS-85-8) Avail: NTIS HC A13/MF A01 CSCL 08/8

This report details the results of a data search on the hydrology

of the coastal watersheds between Ragged Point, San Luis Obispo County and the U.S. - Mexican Border. Included in this report are general hydrological descriptions of the drainage areas, in order to provide background information. These sections are followed by detailed accounts of the sources of hydrologic data which are available. Data of interest include streamflow history at the shoreline of streams and stream groups, volume-frequency analyses, historic hydrographs of major floods, sediment yield, effects of various structures and fire effects. Included in the discussion are the location of data, data formats available and indications of the quality of the data. Data gaps and limitations are noted, and recommendations are presented for reducing these limitations. GRA

N86-31205# Naval Postgraduate School, Monterey, Calif.
OCEANOGRAPHIC ANALYSIS OF SUN GLINT IMAGES TAKEN ON SPACE SHUTTLE MISSION STS 41-G M.S. Thesis
Mark G. Fischer Mar. 1986 42 p
(AD-A167142) Avail: NTIS HC A03/MF A01 CSCL 14/5

A series of four sun glint images taken by the crew of the space shuttle Challenger, mission STS 41-G, on 8 October 1984 were analyzed and compared to NOAA-7 AVHRR infrared images and to bathythermographs of the same area. Evidence of the Almaria Front, a persistant oceanographic feature east of the Alboran Basin, was found on all three data sets, and the efficacy of using sun glint images for the location of acoustically important oceanographic features was supported. A practical use of sun glint photographs taken from low earth orbit was demonstrated and the investigation of its use to help in the employment of acoustic sensors is further justified by this work. Author (GRA)

N86-31206# National Center for Atmospheric Research, Boulder, Colo.
A GENERAL CIRCULATION MODEL INVESTIGATION OF THE ATMOSPHERIC RESPONSE TO EL NINO Ph.D. Thesis - Miami Univ.
Jose Oribe RochadeArago 1986 161 p
(Grant NSF ATM-82-17015)
(PB86-196243; NCAR/CT-100) Avail: NTIS HC A08/MF A01 CSCL 08C

The atmospheric response to sea surface temperature anomalies associated with El Nino episodes is simulated with the use of the NCAR general circulation model. The model features the annual march of both insolation and sea surface temperature. The model's tropical response is similar to the anomalous features which have been found in previous observational studies. For example, the upper level anticyclone pair in the central Pacific is present for almost all months. An anomalous Walker Circulation is found in the vertical plane along the equatorial region. Rainfall departures from the long-term mean are found elsewhere in the entire equatorial belt. GRA

N86-31090# Bremen Univ., (West Germany).
OCEANOGRAPHY
W. Alpers, K. Richter (Deutsches Hydrographisches Inst., Hamburg (West Germany), and P. Lombardini (Consiglio Nazionale delle Ricerche, Turin, Italy) *In* DFVLR The X-SAR Science Plan Nov. 1985 p 97-110 (For primary document see N86-31084 22-42) Avail: NTIS HC A08/MF A01; DFVLR, Cologne DM 32

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N86-31207# Naval Research Lab., Washington, D. C.
ADVANTAGES OF THE GAS EXCHANGE APPROACH TO MICROBIOLOGICAL STUDIES Memorandum Report, 1983 - 1985
P. J. Hannan and D. S. Jones 3 Apr. 1986 43 p
(AD-A166887; NRL-MR-5744) Avail: NTIS HC A03/MF A01 CSCL 06/13

Studies of the effects of various chemical or physical stimuli on the growth rates of microorganisms generally involve some measure of biomass. In the case of algae, one might measure the cell number, the chlorophyll concentration, the fluorescence, or the wet weight of the culture as a function of time. Each such measurement requires a sampling of the culture which could be a disturbing factor in the system being measured. Another disadvantage of these traditional measurements is that the times required for significant change to take place in the culture might be hours or days; furthermore, growth rate measurements calculated from the data must be based on the assumption that during the time between measurements the growth rate was constant. This report describes another approach to the problem. It consists simply of monitoring the O2 or CO2 concentration of an air stream passing through the system (the gas exchange method), and it has several distinct advantages: (1) there is no need to take samples of the culture, (2) each measurement is a rate measurement and indicates the performance of the culture at that very moment, and (3) transitory changes in growth rates are readily detected. Examples are given of studies made previously with this method at NRL. Also the possible value of these methods in a study of the corrosion susceptibility of alloys is described. GRA

N86-31208# Georgia Univ., Athens. Dept. of Chemistry.
THE PREDICTION OF BIOLOGICAL ACTIVITY USING MOLECULAR CONNECTIVITY INDICES
Dennis H. Rouvray 23 Apr. 1986 31 p
(Contract N00014-84-K-0365)
(AD-A166986; TR-21) Avail: NTIS HC A03/MF A01 CSCL 06/15

A highly influential paper by Randic entitled On characterization of molecular branching appeared in the Journal of the American Chemical Society. In this paper a new topological index was introduced which has since become known as the molecular connectivity index. Topological indices (Tis) are graph-theoretical invariants which are employed extensively as matheamtical descriptors for a wide range of molecular species. They have been used mainly for the purpose of correlating the properties of molecular species with their topological structure. The molecular connectivity index was originally put forward with the aim of characterizing the branching in alkane species, but more recently has been shown to have numerous applications in both the physical and biological sciences. In this review we shall focus on the use of the index in the more biologically oriented sciences, such as pharmacology and toxicology. In particular, we shall discuss the prediction of biological activity in chemical species by means of this index. The molecular connectivity index as originally presented by Randic was designed to parallel the ordering obtained for sets of isomeric alkane molecules based on their physicochemical properties. GRA

N86-31209# University of Southern California, Los Angeles.
LASER KINETIC SPECTROSCOPY OF UNIMOLECULAR AND BIMOLECULAR PROCESSES IN THE GAS PHASE Final Report, 1 Oct. 1982 - 30 Sep. 1985
Curt Wittig and Hanna Reisler 15 Nov. 1985 14 p
(Grant AF-AFOSR-0022-83)
(AD-A166998; AFOSR-86-0226TR) Avail: NTIS HC A02/MF A01 CSCL 07/5

This research is concerned with the study of unimolecular processes in the gas phase. We concentrated on simple bond fission reactions, and determined both the collision free unimolecular rates Benzylamine (C6H5CH2NH2), Nitrosomethane (CH3)3CNO), and the energy disposal in the products Nitrosyl cyanide (NCN0), Trifluoronitrile methane (CF3CN), Cyanogeniodide (ICN). Most of the molecules were dissociated either via IRMPD(CF3CN, C6H5CH2NH2) or by electronic excitation followed by radiationless transitions (NCNO(CH3)3CNO). They exhibited statistical behavior, and the results were compared with the predictions of statistical theories. The most detailed experiments involved the photodissociation of NCNO, which provided complete mapping. of product internal states. The CN and NO E,V,R distributions are textbook examples of statistical product state distributions deriving from a unimolecular reaction. In our studies

of the direct photodissociation of ICN, we obtained sub-Doppler LIF spectra of nascent CN(X2 sigmat state), following the 266 nm photolysis of 300 K molecules. These studies provided a detailed picture of the fragment recoil spatial anisotropies as well as CN E,V,R, T and and I/I excitations. The CN rotational distributions were dissected into two separate distributions for the channels producing I and I. GRA

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and weightlessness.

N86-31210# Systems Research Labs., Inc., Dayton, Ohio.
THE EFFECT OF BREATHING ELEVATED CO2 GAS MIXTURES ON TRACKING PERFORMANCE, BLOOD PRESSURE, AND SUBJECTIVE TOLERANCE AT 1Gz
Thomas G. Shriver, Daniel W. Repperger, John W. Frazier, Charles D. Goodyear, and Lloyd D. Tripp Mar. 1986 52 p
(Contract F33615-81-C-0500)
(AD-A165974; AAMRL-TR-86-006) Avail: NTIS HC A04/MF A01 CSCL 06/19

The addition of small concentrations (5-10%) of carbon dioxide (CO2) to the breathing gas has been identified as a possible technique to increase Gz tolerance for pilots. Eight subjects participated in an experiment to examine tracking performance, physiological parameters, and subjective tolerance when breathing the four following gas mixtures: air; 100% O2; 2.5% CO2 and 97.5% O2; and 3.5% CO2 and 96.5% O2. Tracking performance was not significantly different when breathing any of these four gas mixtures. Learning, which continued to occur throughout the experiment, was inhibited when the subjects were breathing the 3.5% CO2 mixture. When using either of the CO2 mixtures there was a significant increase in relative respiratory volume and a modest increase in systolic (11 mm Hg) and diastolic (6 mm Hg) blood pressure. One subject, when breathing 3.5% CO2, aborted the run after 12 minutes because of air hunger. GRA

N86-31211# Army Research Inst. of Environmental Medicine, Natick, Mass.
METABOLIC CHANGES FOLLOWING ECCENTRIC EXERCISE IN TRAINED AND UNTRAINED MEN
W. J. Evans, C. N. Meredith, J. G. Cannon, C. A. Dinarello, and W. R. Frontera 1986 24 p
(AD-A166521; AD-E900544; USARIEM-M-20/86) Avail: NTIS HC A02/MF A01 CSCL 06/16

The effects of one 45 minute bout of high intensity eccentric exercise (250 Watts) were studied in 4 male runners and 5 untrained men. Plasma creatine kinase (CK) activity in these runners was high ($p < 0.001$) than in the untrained men before exercise and peaked at 207 IU/ml one day after exercise, while in untrained men the maximum was 2143 IU/ml five days after exercise. Plasma interleukin-1 (IL-1) in the trained men was also higher ($p < 0.001$) than in the untrained men before exercise but did not significantly increase after exercise. In the untrained men, IL-1 was significantly elevated 3 hours after exercise ($p < 0.001$). In the untrained group only, 24-hour urines were collected before and after exercise while the men consumed a meat-free diet. Urinary 3-methylhistidine/creatinine in the untrained group rose significantly from 126 umol/g before exercise to 180 umol/g ten days after exercise. The results suggest that in untrained men, eccentric exercise leads to a metabolic response indicative of delayed muscle damage. Regularly performed long distance running was associated with chronically elevated plasma IL-1 levels and serum CK activities without acute increases after an eccentric exercise bout. GRA

N86-31212# Army Research Inst. of Environmental Medicine, Natick, Mass.
INDUCED ERYTHROCYTHEMIA AND MAXIMAL AEROBIC POWER: AN EXAMINATION OF MODIFYING FACTORS
Michael N. Sawka, Andrew J. Young, Stephen R. Muza, Richard R. Gonzalez, and Kent B. Pandolf Apr. 1986 23 p
(AD-A166522; AD-E900544; USARIEM-M-22/86) Avail: NTIS HC A02/MF A01 CSCL 06/5

Induced erythrocythemia is associated with an increase in maximal oxygen uptake. Two factors which might influence inter-subject variability for this increase in maximal oxygen uptake are the magnitude of change in hemoglobin concentration and the individual's initial aerobic fitness. To examine these factors, we have obtained and combined individual data from our own research and three other studies which employed similar procedures. In each study freeze-preserved erythrocytes representing the product of two blood units were reinfused and maximal oxygen uptake was measured within 24 to 72-h after reinfusion. The 30 subjects had an initial aerobic power which ranged from 36 to 88 ml 02/dg/min. The combined results from these studies indicate that after erythrocyte reinfusion: 1) the increase in hemoglobin concentration is fairly homogeneous; 2) nearly all individuals demonstrate an increase in maximal oxygen uptake; 3) the magnitude of increase in hemoglobin concentration is not related to the magnitude of increase in maximal oxygen uptake is related to the individual's initial aerobic fitness. Individuals with an initial aerobic fitness between 50 to 64ml O2/kg/min experience approximately twice the increase in maximal oxygen uptake after erythrocyte reinfusion compared to individuals with lesser or greater fitness. GRA

N86-31213# Army Research Inst. of Environmental Medicine, Natick, Mass.
INTRINSIC ALTERATION OF THE REACTIVE PROPERTIES OF ARTERIES DURING HYPOTHERMIA
N. R. Bandick and Donald E. Roberts 21 Mar. 1986 23 p
(AD-A166523; AD-E900544; USARIEM-M-21/86) Avail: NTIS HC A02/MF A01 CSCL 06/5

This study compared the reactive and contractile properties of helical strips of femoral arteries taken from normothermic rabbits and rabbits that were anesthetized with pentobarbitol and cooled to 25 C at a rate of 7 C per hour. The purpose of this comparison was to see if intrinsic factors would alter the sensitivity and/or contractility of this vascular muscle to norepinephrine during whole body hypothermia. We found that, after two hours of in vivo hypothermia, the hypothermic derived tissue was from 10 to 100 times more sensitive to norepinephrine than the normothermic derived tissue. This augmented sensitivity continued while the tissue was in vitro for at least twelve hours. The dose-response curves of the hypothermic derived arteries were shifted to the left of the normothermic arteries resulting in a greater contractility at lower levels of agonist. Moreover, the normothermic tissue contracted slower than the hypothermic. The maximal tension developed by the strips was equivalent. This study has identified prolonged alterations of receptor sensitivities and contractility properties attributable to in vivo influences that can, in part, explain the disruptions of blood pressure during and following whold body hypothermia. GRA

N86-31214# Air Force Occupational and Environmental Health Lab., Brooks AFB, Tex.
ASSESSING POSSIBLE DAMAGE DUE TO RADIO FREQUENCY RADIATION Final Report
Bruce J. Poitrast Feb. 1986 13 p
(AD-A166913; OEHL-86-020C0111BRA) Avail: NTIS HC A02/MF A01 CSCL 06/18

This report is written in response to requests from the field for guidance in the clinical examination of radio frequency radiation exposures. The report contains basic information on radio frequency radiation and its biological interactions. It also contains a suggested history and physical examination, a list of expected clinical findings, and suggestions for referral if necessary. GRA

N86-31215# Pacific Northwest Labs., Richland, Wash.
PHYSICAL INTERACTION OF HUMANS AND ANIMALS WITH POWER-FREQUENCY ELECTRIC AND MAGNETIC FIELDS
W. T. Kaune Feb. 1986 11 p Presented at the IEEE Power Engineering Society Winter Meeting, New York, N.Y., 2 Feb. 1986

(Contract DE-AC06-76RL-01830)
(DE86-007734; PNL-SA-13716; CONF-860210-3) Avail: NTIS HC A02/MF A01

Research has been underway for more than 15 years investigating the biological and physical interactions of power-frequency electric fields coupled to humans and animals through the air dielectric around electric-power facilities. Currently, fairly detailed analyses can be made for homogeneous human- and animal-shaped models standing on ground while exposed to a vertical electric field. Some data are available for ungrounded exposure conditions. However, little is known about the effects of the nonuniform electrical properties of living tissues on induced-current distributions. Recently, interest has also developed in the interaction of humans and animals with power-frequency magnetic fields. Little data are available, and only simple estimates, using homogeneous ellipsodial models, can be made at present. Relatively simple calculational techniques are available, however, to analyze two- and three-dimensional models of humans and animals, and it can be expected that considerable progress will be made in the next few years. DOE

N86-31426*# Texas A&M Univ., College Station. Dept. of Biomedical Engineering.
ANALYSIS OF NYSTAGMUS RESPONSE TO A PSEUDORANDOM VELOCITY INPUT
Charles S. Lessard *In* NASA. Johnson Space Center NASA/American Soceity for Engineering Eduction (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 104 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 06P

N86-31428*# Texas Univ., Galveston. Dept. of Internal Medicine.
FLOW CYTOMETRY ANALYSIS OF HORMONE RECEPTORS ON HUMAN PERIPHERAL BLOOD MONONUCLEAR CELLS TO IDENTIFY STRESS-INDUCED NEUROENDOCRINE EFFECTS
Richard T. Meehan *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 7 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 06P

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N86-31216# California Univ., Los Angeles. Medical Center.
NEUROPHYSIOLOGICAL RESEARCH SUPPORTING THE INVESTIGATION OF ADAPTIVE NETWORK ARCHITECTURES Final Report, 1 Mar. 1983 - 28 Feb. 1985
Charles D. Woody 14 Aug. 1985 90 p
(Contract F49620-83-C-0077)
(AD-A166074; AFOSR-86-0083TR) Avail: NTIS HC A05/MF A01 CSCL 06/16

The investigators have shown that single cortical neurons adapt in such a way as to support learned behavior. What is particularly interesting is the indication that purposefully complex, molecular cascades exist at the level of single nerve cells to permit successful adaptions to occur. Successful adaptions are defined as: (a) producing the desired alteration of response to the appropriate input, (b) enduring over time, (c) not interfering with other adaptions occurring for another purpose in the same cell, and (d) not interfering with the main-throughput-message transfer property of the nerve cell. The result of these adaptations is to support the operation of a self-organizing information processing system with a high success: error ratio and excellent survivability in the face of substantial environmental change. Changes in the excitability of cortical neurons occur that lead to acquisition of the ability to perform specific motor tasks in response to specific auditory stimuli. Rates of acquiring this ability can be substantially increased by adding electrical stimulation of the hypothalamus associatively, to presentations of conventional conditioned and unconditioned stimuli. Part of this acceleration of learning the motor response may derive from recruitment of a new performance pathway-reflected in a longer transmission latency for movement production. A long range goal of the research is to understand how the system picks the right pathway. GRA

N86-31217# Northwestern Univ., Evanston, Ill. Vision Lab.
SENSITIVITY TO VISUAL MOTION IN STATISTICALLY DEFINED DISPLAYS Final Report, Nov. 1981 - Nov. 1982
R. W. Sekuler, D. W. Williams, and S. A. Harp Mar. 1986 148 p
(Contract MDA903-80-C-0154; DA Proj. 2Q1-61102-B-74-F)
(AD-A167291; ARI-RN-86-30) Avail: NTIS HC A07/MF A01 CSCL 05/10

This project explored aspects of how human observers perceive moving targets, particularly targets whose motion is apparent rather than continuous. Major topics covered include origins of global motion Percepts, and size factors in apparent motion. GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N86-31218*# Georgia Inst. of Tech., Atlanta. Center for Man-Machine Systems Research.
PILOT INTERACTION WITH AUTOMATED AIRBORNE DECISION MAKING SYSTEMS Semiannual Progress Reports, Aug. - Jul. 1985
William B. Rouse, John M. Hammer, Christine M. Mitchell, Nancy M. Morris, C. Michael Lewis, and Wan C. Yoon Jul. 1985 50 p
(Grant NAG2-123)
(NASA-CR-176986; NAS 1.26:176986) Avail: NTIS HC A03/MF A01 CSCL 05H

Progress was made in the three following areas. In the rule-based modeling area, two papers related to identification and significane testing of rule-based models were presented. In the area of operator aiding, research focused on aiding operators in novel failure situations; a discrete control modeling approach to aiding PLANT operators was developed; and a set of guidelines were developed for implementing automation. In the area of flight simulator hardware and software, the hardware will be completed within two months and initial simulation software will then be integrated and tested. For individual titles, see N86-31219 through N86-31220.

N86-31219*# Georgia Inst. of Tech., Atlanta.
REPRESENTATION FOR CLOSED FORM SIGNIFICANCE TESTING IN VL1
C. Michael Lewis *In its* Pilot Interaction With Automated Airborne Decision Making Systems Jul. 1985 11 p (For primary document see N86-31218 22-54)
Avail: NTIS HC A03/MF A01 CSCL 05H

Within the constraints of the syntax language, the set of observation descriptions which determines the discriminations which can be made, and the number of observations classified, a method is to be devised for determining the relative frequency over instantiation with which a rule of equal or greater generality would be identified. Generality, here, is defined as the number of observations described by a rule. A covering algorithm (Aq, Michalski 1973) was used to identify pilot strategy (system of rules) in maneuvering to avoid intruders. B.G.

N86-31220*# Georgia Inst. of Tech., Atlanta.
A DISCRETE CONTROL MODEL OF PLANT
Christine M. Mitchell *In its* Pilot Interaction With Automated Airborne Decision Making Systems Jul. 1985 31 p (For primary document see N86-31218 22-54)

Avail: NTIS HC A03/MF A01 CSCL 05H

A model of the PLANT system using discrete control modeling techniques developed by Miller is described. Discrete control models attempt to represent in a mathematical form how a human operator might decompose a complex system into simpler parts and how the control actions and system configuration are coordinated so that acceptable overall system performance is achieved. Basic questions include knowledge representation, information flow, and decision making in complex systems. The structure of the model is a general hierarchical/heterarchical scheme which structurally accounts for coordination and dynamic focus of attention. Mathematically, the discrete control model is defined in terms of a network of finite state systems. Specifically, the discrete control model accounts for how specific control actions are selected from information about the controlled system, the environment, and the context of the situation. The objective is to provide a plausible and empirically testable accounting and, if possible, explanation of control behavior. B.G.

N86-31221# Midwest Research Inst., Kansas City, Mo.
DEVELOPMENT OF THERMOELECTRIC WATER HEATING-COOLING DEVICES Final Rept. Feb. - Oct. 1985
B. Mathipraksam 25 Oct. 1985 28 p
(Contracts DAAK60-85-C-0011; DA Proj. 1L1-62724-AH-99)
(AD-A166949; NATICK-TR-86/019) Avail: NTIS HC A03/MF A01 CSCL 13/1

A simple, safe, and reliable thermoelectric device for heating or cooling potable water for use in military vehicles was developed. The unit is capable of cooling water to 60 F in ambient temperatures up to 130 F and heating to 150 F in ambient temperatures of 40 F. Freezing/overheating and undervoltage protections are provided. The unit has also cooling/heating indicators, water ready indicators, and automatic switch off. A total of six units were built, tested, and delivered to U.S. Army Natick R&D Center.
Author (GRA)

N86-31222# Sandia National Labs., Albuquerque, N. Mex.
MAKING THE HUMAN-MACHINE INTERFACE RESPONSIVE TO MANY CLASSES OF USERS
R. W. Barnard 1986 15 p Presented at the DECUS Symposium, Dallas, Tex., 27 Apr. 1986
(Contract DE-AC04-76DP-00789)
(DE86-003453; CONF-860470-1) Avail: NTIS HC A02/MF A01

An applications program must be able to interact with users who have a range of familiarity with its operation. A novice user needs more guidance than an experienced one, and a rigid type of interaction (such as menus) will not meet the needs of all users. Frustrations with the program are reduced and productivity is increased by using a flexible means of response which matches the level of response to the needs of the user. This paper illustrates techniques to provide only as much guidance as the user requires. The methods discussed here permit the user to switch among three levels of guidance (none, short prompts, and menus) and to have context-sensitive help readily available. Because frequent users of a program will soon become quite proficient, supplying default answers and command entry shortcuts are also beneficial. These techniques have been used in a program which meets the needs of users who have all ranges of proficiency. DOE

N86-31223# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho. System Safety Development Center.
BASIC HUMAN FACTORS CONSIDERATIONS
R. J. Nertney and D. L. Fillmore Dec. 1985 37 p
(Contract DE-AC07-76ID-01570)
(DE86-008181; SSDC-34) Avail: NTIS HC A03/MF A01

Models and concepts for analyzing the human element in working programs and systems are introduced. The method of attack is a functional one based on analysis of the work to be done (job-task analysis). Based on the results of the job-task analysis, psychological and physiological requirements and criteria can be defined for the system. DOE

N86-31224# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho. System Safety Development Center.
IMPACT OF THE HUMAN ON SYSTEM SAFETY ANALYSIS
R. J. Nertney and R. L. Horman Sep. 1985 34 p
(Contract DE-AC07-76ID-01570)
(DE86-008182; SSDC-32) Avail: NTIS HC A03/MF A01

The impact of the human and human reliability on the results of probabilistic risk assessment studies is discussed in terms of some of the standard models used in risk quantification. Three levels of analysis are considered: (1) identification of areas where the human affects the operational risks; (2) rough scaling and quantification of the effect of the human on operational outcome; and (3) complete quantification of the risks including consideration of human reliability. DOE

N86-31225# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
PROCESS OF TASK ANALYSIS
H. S. Blackman, D. I. Gertman, and L. N. Haney Sep. 1985 32 p
(Contract DE-AC07-76ID-01570)
(DE86-008183; EGG-SSDC-31) Avail: NTIS HC A03/MF A01

The paper presents a task analysis form for the organization of task analysis efforts. In terms of the form, task descriptions for use in task analysis data collection are given, and detailed definitions of 35 task analysis categories are offered. The categories include important aspects of task performance, consequences, and feedback, as well as aspects of training and knowledge requirements. Methods behind the derivations of tasks and subtasks, and category analysis are explained. Aspects of data applications concerning who and how are discussed. Task analysis can be used in the development of behavioral learning objectives and instructional strategies. Action verbs are often used in category analysis and human capabilities identification. Curriculum and tests may be developed by analyzing what people do and need in their jobs. The process of task analysis is a useful tool in the analysis and improvement of human job performance.
DOE

N86-31226# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho. System Safety Development Center.
HUMAN FACTORS MANAGEMENT
R. J. Nertney and D. L. Fillmore Jul. 1985 44 p
(Contract DE-AC07-76ID-01570)
(DE86-008184; SSDC-30) Avail: NTIS HC A03/MF A01

Evaluating a system to determine if it has the right people working using the right procedures and management controls with the right hardware at all times is the facet of human factors discussed in this manual. The following areas of concern are specifically addressed: (1) the selection process must be proper to select qualified workers who are given proper training for the work and whose skills are maintained; (2) a proper behavioral climate must be established at the work station; (3) all task assignments must contain elements of instruction and training; and (4) all supporting systems must interact with the human to ensure that the work can be completed. All of these areas of concern can be successfully completed using the existing company organization by following the considerations presented in this document and maintaining proper interfaces between the different branches of the company. DOE

N86-31412*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
EVALUATING SPACE STATION APPLICATIONS OF AUTOMATION AND ROBOTICS TECHNOLOGIES FROM A HUMAN PRODUCTIVITY POINT OF VIEW
Jonathan F. Bard *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 46 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 05H

N86-31422*# Utah Univ., Salt Lake City. Center for Occupational and Environmental Health.

DEFINING RECLAIMED WATER POTABILITY REQUIREMENTS
Daniel S. Janik *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 49 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 06K

55 PLANETARY BIOLOGY

Includes exobiology; and extraterrestrial life.

N86-31421*# East Carolina Univ., Greenville, N.C. Dept. of Biology.
EFFECTS OF LUNAR SOIL, ZAGAMI METEORITE, AND OCEAN RIDGE BASALT ON THE EXCRETION OF ITOIC ACID, A SIDEROPHORE, AND COPROPORPHYRIN BY BACILLUS SUBTILIS
Takeru Ito *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 12 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 06C

N86-31431*# Texas Univ., Houston. Dept. of Environmental Sciences.
CYTOGENETIC ANALYSES OF PERIPHERAL LYMPHOCYTES SUBJECTED TO SIMULATED SOLAR FLARE RADIATION
Howard M. Prichard *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 9 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 06R

N86-31436*# Houston Univ., Tex. Dept. of Human Development.
SELECTION OF AN APPROPRIATE ANIMAL MODEL FOR STUDY OF BONE LOSS IN WEIGHTLESSNESS
Ira Wolinsky *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 7 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 06S

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N86-31227*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
[SUMMARY OF RESEARCH IN APPLIED MATHEMATICS, NUMERICAL ANALYSIS, AND COMPUTER SCIENCES] Final Semiannual Report, 3 Oct. 1985 - 31 Mar. 1986
Apr. 1986 57 p
(Contract NAS1-18107)
(NASA-CR-178119; NAS 1.26:178119) Avail: NTIS HC A04/MF A01 CSCL 12A

The major categories of current ICASE research programs addressed include: numerical methods, with particular emphasis on the development and analysis of basic numerical algorithms; control and parameter identification problems, with emphasis on effective numerical methods; computational problems in engineering and physical sciences, particularly fluid dynamics, acoustics, and structural analysis; and computer systems and software, especially vector and parallel computers. B.G.

N86-31228# Kentucky Univ., Lexington. Dept. of Statistics.
PROCEEDINGS OF THE 17TH SYMPOSIUM ON THE INTERFACE OF COMPUTER SCIENCE AND STATISTICS Report, for 1 Mar. 1985 - 4 Mar. 1986
4 Mar. 1986 311 p Symposium held in Lexington, Ky., 17-19 Mar. 1985
(Contract N00014-85-G-0157)
(AD-A166019) Avail: NTIS HC A14/MF A01 CSCL 12/1

The Seventeenth Symposium on the Interface of Computer Sciences and Statistics was held in the Radisson Plaza Hotel, Lexington, Kentucky on March 17-19, 1985. The sessions encompassed a broad range of topics. A number of sessions dealt with computational methods for traditional statistical areas. These included time series, nonlinear models, repeated measures data analysis, and categorical data analysis. Some sessions were in the relatively new areas of statistics such as artificial intelligence, the metadata of computational processes, statistical computing languages, and statistical workstations. There were also sessions in numerical methods, density estimation, teaching of statistical computing, statistical and mathematical software and graphics. During one session the entire audience participated in a round table discussion on the performance of statisticians with statistical software. Written versions of nearly all these papers are in this volume. GRA

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.
For components see *33 Electronics and Electrical Engineering.*

N86-31229# Softech, Inc., Fairborn, Ohio.
ADA (TRADE NAME) COMPILER VALIDATION SUMMARY REPORT: AFATL ADA CROSS-COMPILER VERSION 1.0, CDC CYBER HOST/ZILOG Z8002 TARGET Final Report, 6 Dec. 1985 - 6 Dec. 1986
6 Dec. 1985 52 p
(Contract F33600-84-D-0280)
(AD-A166212) Avail: NTIS HC A04/MF A01 CSCL 09/2

The purpose of this Validation Summary Report is to present the results and conclusions of performing standardized tests on the Air Force Armament Laboratory (AFATL) Ada Compiler, developed by Florida State University (FSU). The AFATL Ada Compiler (Version 1.0) is hosted on the CDC Cyber 170/760 and targeted to the Zilog Z8002 Development Module. The suite of tests known as the Ada Compiler Validation Capability (ACVC), Version 1.6, was used. The purpose of the testing is to ensure that the compiler properly implements legal language constructs and that it identifies, rejects from processing, and labels illegal language constructs. The testing also identifies implementation-dependent behavior permitted by the standard. Six classes of tests are used. These tests are designed to perform checks at compile time, during execution, and at link time. GRA

N86-31230# Softech, Inc., Waltham, Mass.
ADA (TRADE NAME) TRAINING CURRICULUM. REAL-TIME SYSTEMS IN ADA L401 TEACHER'S GUIDE, VOLUME 1
1986 376 p
(Contract DAAB07-83-C-K514)
(AD-A166351) Avail: NTIS HC A17/MF A01 CSCL 05/9

Course outline: Part 1 Concurrent Programming Concepts Section (1) Concurrent Processes, Section (2) Reasons for Concurrency, (3) Concurrent Programming Problems; Part 2 Ada Tasking Concepts (4) Task Types and Task Objects, (5) Task Declarations and Task Types, (6) Task Activition and Termination; and Part 3 Task Cooperation (7) Simple Rendezvous, (8) Selective Waits, (9) Select Statements for Making Entry Calls, (10) Avoiding Deadlock. GRA

N86-31231# Softech, Inc., Waltham, Mass.
ADA (TRADE NAME) TRAINING CURRICULUM. REAL-TIME SYSTEMS IN ADA L401 TEACHER'S GUIDE, VOLUME 2
1986 560 p Supersedes report dated Jul. 1984, AD-A146783

(Contract DAAB07-83-C-K514)
(AD-A166352) Avail: NTIS HC A24/MF A01 CSCL 05/9

Course outline:(continued): Part 4 Fundamental Task Designs (11) Server and User Tasks, (12) Monitors, (13) Message Buffers, (14) Cyclic Processing, (15) Stream-Oriented Task Design; Part 5 Other Tasking Features (16) Aborting Tasks, (17) Exceptions in Multitask Programs, (18) Interrupt Entries, (19) Entry Families, (20) TAsk Priorities; Part 6 Improving Performance (21) When and Why to Tune, (22) Shared Variables, (23) Minimizing Blocking, (24) Merging Tasks, (25) Non-Concurrent Tuning, (26) What's Best Left to the Compiler; and Part 7 Module Wrap-up (27) A Complete Example. GRA

N86-31232# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Information Systems and Technology Center.
ADA (TRADE NAME) COMPLIER VALIDATION SUMMARY REPORT: VERDIX ADA DEVELOPMENT SYSTEM, VERSION 5.2 FOR THE SEQUENT BALANCE UNDER DYNIX, RELEASE 1.3.2
15 Nov. 1985 79 p
(AD-A167231; AVF-VSR-15.0286) Avail: NTIS HC A05/MF A01 CSCL 09/2

The Validation Summary Report describes how an Ada compiler conforms to the language standard. This report explains all technical terms used within it and thoroughly reports the Ada Compiler Validation Capability test results. Ada compilers must be written according to the language specification as given in ANSI/MIL-STD-1815A Ada. All implementation-defined features must be included for the compiler to conform to the Standard. Following the guidelines of the Standard ensures continuity between compilers. That is, the entire Standard must be implemented, and nothing can be implemented that is not in the standard. Even though all validated Ada compilers conform to the Standard, it must be understood that some differences do exist between implementations. ANSI/MIL-STD-1815A permits some implementation dependencies--e.g., the maximum length of identifiers, the maximum values of integer types, etc. These implementation-dependent features limit the portability of programs between compilers. Other differences between compilers are due to limitations imposed on a compiler by the operating system and by the hardware. All of these dependencies are given in the report. GRA

N86-31233# Sandia National Labs., Albuquerque, N. Mex.
DATA FLOW ACCELERATOR MODULE FOR GENERAL PURPOSE PROCESSORS
1986 25 p
(Contract DE-AC04-76DP-00789)
(DE86-008405; SAND-86-0710C) Avail: NTIS HC A02/MF A01

This invention is a Data Flow Accelerator Module (DFAM) designed to promote use of parallelism by general purpose processors. The DFAM is a tagged architecture memory module used to accelerate execution of parallel algorithms using small grain computations. The DFAM architecture allows the modularization of software tasks into much finer grains than was previously reasonable because it drastically reduces the communication and synchronization overheads. DOE

N86-31234# Siemens A.G., Munich (West Germany). Unternehmensbereich Bauelemente.
DEVELOPMENT OF DYNAMIC VERY LARGE SCALE INTEGRATION MEMORIES Final Report, Jan. 1985
Dieter Kantz, Willibald Meyer, and Heinz Schulte Bonn Bundesministerium fuer Forschung und Technologie Dec. 1985 117 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-85-176; ISSN-0340-7608; ESA-86-97448) Avail NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 24.50

A 256K MOS dynamic random access memory including manufacturing technology was developed. The storage cell for increased storage capacity, the low-ohmic tantalum silicide, laser redundancy for yield improvement, and nibble mode as an operation with higher data bandwidth are described. Developments in testing, analyzing, and reliability are outlined. The chip size is 45 sqmm. An access time of 150 nsec is achieved. ESA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N86-31235*# Stanford Univ., Calif. Applied Psychology Lab.
COGNITIVE AND PERCEPTUAL PRINCIPLES OF WINDOW-BASED COMPUTER DIALOGUES Annual Progress Report, Dec. 1985 - Nov. 1986
M. Pavel and S. Card 1986 100 p
(Grant NAG2-269)
(NASA-CR-176964; NAS 1.26:176964) Avail: NTIS HC A05/MF A01 CSCL 09B

The information-space flyer concept is similar to a flight simulator where one traverses over information topology (such as a sematic network) rather than a geographical terrain. Research and software engineering are discussed. Also included is a user manual. B.G.

N86-31236*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EXPECTED PERFORMANCE OF m-SOLUTION BACKTRACKING Final Report
David M. Nicol Aug. 1986 26 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178162; NAS 1.26:178162; ICASE-86-55) Avail: NTIS HC A03/MF A01 CSCL 09B

This paper derives upper bounds on the expected number of search tree nodes visited during an m-solution backtracking search, a search which terminates after some preselected number m problem solutions are found. The search behavior is assumed to have a general probabilistic structure. The results are stated in terms of node expansion and contraction. A visited search tree node is said to be expanding if the mean number of its children visited by the search exceeds 1 and is contracting otherwise. It is shown that if every node expands, or if every node contracts, then the number of search tree nodes visited by a search has an upper bound which is linear in the depth of the tree, in the mean number of children a node has, and in the number of solutions sought. Also derived are bounds linear in the depth of the tree in some situations where an upper portion of the tree contracts (expands), while the lower portion expands (contracts). While previous analyses of 1-solution backtracking have concluded that the expected performance is always linear in the tree depth, the model allows superlinear expected performance. Author

N86-31237*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
GEOMETERIAL DESCRIPTION FOR A PROPOSED AEROASSIST FLIGHT EXPERIMENT VEHICLE
F. McNeil Cheatwood, Fred J. DeJarnette (North Carolina State Univ., Raleigh.), and H. Harris Hamilton, II Jul. 1986 38 p
(NASA-TM-87714; NAS 1.15:87714) Avail: NTIS HC A03/MF A01 CSCL 09B

One geometry currently under consideration for the Aeroassist Flight Experiment (AFE) vehicle is composed of several segments of simple general conics: an ellipsoidal nose tangent to an elliptical cone and a base skirt with the base plane raked relative to the body axis. An analytic representation for the body coordinates and first and second partial derivatives of this configuration has been developed. Equations are given which define the body radius and partial derivatives for a prescribed axial and circumferential position on the vehicle. The results for a sample case are tabulated and presented graphically. Author

N86-31238# Softech, Inc., Waltham, Mass.
ADA (TRADE NAME) CURRICULUM. BASIC ADA PROGRAMMING L202 TEACHER'S GUIDE. LABORATORY MANUAL AND

EXERCISES
1986 76 p Revised
(Contract DAAB07-83-C-K514)
(AD-A166043) Avail: NTIS HC A05/MF A01 CSCL 09/2

This Army training manual or Basic Ada Programming contains exercises to be completed during the laboratory training sessions. They cover such topics as procedure names, object declarations and attributes, directing output to a file, programming to compute the cross product of two vectors, programming inventory systems, storing aircraft records, and programming to suppress information. GRA

N86-31239# Softech, Inc., Waltham, Mass.
ADA (TRADE NAME) TRAINING CURRICULUM. BASIC ADA PROGRAMMING L202 TEACHER'S GUIDE, VOLUME 1
1986 622 p Supersedes report dated May 1984, AD-A143584
(Contract DAAB07-83-C-K514)
(AD-A166366) Avail: NTIS HC A99/MF A01 CSCL 09/2

This course teaches a working subset of the Ada Language. Its intended audience is beginning Ada programmers with little experience with Ada. However this course does require the student to have working knowledge of at least one high order programming language. The course presents the fundamental concepts of the language. This course does not attempt to teach the full Ada language. Course Outline (partial): (1) Introduction to Software Engineering; (2) Ada Technical Overview; (3) Lexical Elements; (4) Introduction to Data; (5) Enumeration Types and Control Structures; (6) Numeric Types; (7) Additional Features of Scalar Types; and (8) Array Types and Iterative Control Structures. GRA

N86-31240# Softech, Inc., Waltham, Mass.
ADA (TRADE NAME) TRAINING CURRICULUM. BASIC ADA PROGRAMMING L202 TEACHER'S GUIDE, VOLUME 2
1986 591 p Supersedes report dated May 1984, AD-A143585
(Contract DAAB07-83-C-K514)
(AD-A166367) Avail: NTIS HC A25/MF A01 CSCL 09/2

This course teaches a working subset of the Ada language. Its intended audience is beginning Ada programmers with little experience with Ada. However, this course does require the student to have a working knowledge of at least one high order programming language. The course presents the fundamental concepts of the language. This course does not attempt to teach the full Ada language. Course Outline (continued): (9) record types; (10) access types; (11) program structure and separate compilation; (12) using library units; (13) packages; 14) exceptions; (15) input/output; and (16) overview of other language features. GRA

N86-31241# Lamont-Doherty Geological Observatory, Palisades, N. Y.
SYNTHETIC SEISMOGRAMS, GRAPHIC SOFTWARE AND COMPUTER FACILITIES Final Report, Sep. 1984 - May 1985
David W. Simpson May 1985 12 p
(Contract F19628-84-K-0046)
(AD-A166517; AFGL-TR-85-0306) Avail: NTIS HC A02/MF A01 CSCL 09/2

A SUN-1/100U graphic workstation, which was installed in the Seismology Computing Lab. at Lamont-Doherty, has become the centerpiece of a digital waveform processing and analysis facility. A local area network (LAN) comprising Ethernet/TCP-IP protocols connects the SUN-1 with the Observatory's pre-existing VAX 11/780 and PDP 11/70 installations. The operating systems on the VAX (VMS) and the PDP (Unix bsd 2.9) were updated and modified to provide support for the full set of Ethernet utilities. The Ethernet LAN is undergoing start-up testing and soon will be fully operational. While the SUN-1 offers only rudimentary computational power, its state-of-the-art graphic capabilities have enabled us to develop a quick-look digital data-handling facility. Once the network is fully operational, the resources of the Observatory's other computer laboratories will become available to the SUN-1. The VAX will be used as the network file-server, peripheral handler, and computational node, while the SUN will be used for the graphic analysis of waveforms and digital images. Preliminary experiments with the network suggest that powerful graphic workstations integrated vertically with file-servers, computational nodes, and supercomputer communication capability provide a flexible, powerful, and productive computational environment for research in seismology and tectonophysics. GRA

N86-31242# Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.
ABSTRACTIONS FOR FAULT TOLERANCE IN DISTRIBUTED SYSTEMS Interim Report
Fred B. Schneider Apr. 1986 9 p
(Contract N00014-86-K-0092)
(AD-A166549; CU-CSD-TR-86-745) Avail: NTIS HC A02/MF A01 CSCL 09/2

This paper describes abstractions that are useful in implementing fault-tolerant and distributed systems. The same abstractions serve both fault tolerance and distribution, supporting our belief that the two concerns are not separable. The abstractions we present have a somewhat different flavor from abstractions prevalent in sequential and concurrent programming, which encapsulate state information and/or provide operations to manipulate that state (e.g., a stack or a monitor). Our abstractions are best thought of as properties of protocols or control. Section 2 describes abstractions of processors that can fail and section 3 reviews some fundamentals for coping with failures. Section 4 discusses the state machine approach, a general way to construct fault-tolerant distributed computing services. The state machine approach motivates two abstractions: Agreement and Order. Section 5 discusses a second approach for constructing a fault-tolerant computing service and this motivates two more abstractions: Failure Detection and Stable Storage. Implementing abstractions by exploiting hardware is discussed in section 6. Section 7 discusses related work. GRA

N86-31243# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A QUANTITATIVE CHARACTERIZATION OF CONTROL FLOW CONTEXT: SOFTWARE MEASURES FOR PROGRAMMING ENVIRONMENTS M.S. Thesis
James W. Howatt 1985 146 p
(AD-A166762; AFIT/CI/NR-86-37D) Avail: NTIS HC A07/MF A01 CSCL 09/2

A review of published measures of control flow complexity in programs reveals three major deficiencies; loss of information, lack of specificity, and lack of analytical support. A new approach is used to characterize the control structure of a program, with the aim of defining properties and measures of control flow that can be of immediate use to programmers, regardless of their utility as complexity measures. Mathematical rigor and analytical evaluation techniques are used to define a set of properties of control structure and a corresponding vector of measures. Instead of defining the properties and measures for an entire flowgraph, they are defined at the node level, reflecting the control flow surrounding each node in a flowgraph. The properties and their measures reflect the following characteristics of control flow; nesting, iteration, structuredness, and predecessors. Algorithms for computing the properties and their measures are presented. An assessment of the computational complexity of the algorithms shows that they are feasible programming environment tools. A finite path set, representing all possible execution sequences, is evaluated as a characterizing property. Desired characteristics of the path set are defined and used to evaluate four published path subset criteria. Those criteria are shown to be deficient, so a fifth criterion is defined. However, the path set satisfying this fifth criterion is shown to be too large to be of practical use to a programmer. DOE

N86-31244# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
SOLVING MULTI-STATE VARIABLE DYNAMIC PROGRAMMING MODELS USING VECTOR PROCESSING M.S. Thesis
Stuart W. Stopkey Dec. 1985 111 p
(AD-A166763; AFIT/CI/NR-86-45T) Avail: NTIS HC A06/MF A01 CSCL 09/2

One of the classical allocation models is known as the pallet loading problem. It consists of optimally loading parcels with various

weight and volume parameters on a pallet. This pallet has weight and volume limits which constrain the amount of parcels that can be loaded. An optimal load is that combination of parcels which maximized the summed utilities of all parcels that are loaded. The pallet loading problem can ge generalized to a 2-state variable (weight and volume) Dynamic Programming model. However, the problem can be solved by other methods. In the past, these other methods were preferred due to the difficulty of Dynamic Programming in solving problems of more than one state variable. With the advent of new computer technology in the form of vector processing, that difficulty can be overcome. The efficient column manipulating nature of vector processing is a perfect match for the column nature of the Dynamic Programming problem formulation. Based upon the algorithm developed using the ideas for vector processing, Dynamic Programming can be considered a very efficient solution technique to the 2-state variable problem. Using the vector processing capability of the ETA Systems supplied CDC Cyber 205, 2-state variable problems too large to be solved previously using DP can now be solved with small computational times. Also, an analysis of the results show that computation time increases linearly as the problem parameters are increased, not exponentially. Author (GRA)

N86-31245# Massachusetts Inst. of Tech., Cambridge.
COMPUTER-AIDED FABRICATION SYSTEM IMPLEMENTATION Semiannual Report, 1 Oct. 1985 - 31 Mar. 1986
Paul Penfield, Jr., Stanley B. Gershwin, Dimitri A. Antoniadis, and Donald E. Troxel 31 Mar. 1986 22 p
(Contract N00014-85-K-0213)
(AD-A166787) Avail: NTIS HC A02/MF A01 CSCL 09/2

This report covers the period from October 1, 1985 through March 31, 1986. The research discussed here is described in more detail in several published and unpublished reports cited below. During this period, the installation of the central computing machine for the MIT CAF work, known as CAF and all the necessary software was substantially completed. The machine is a VAX 11/785. It has a large cadre of users. A rudimentary CAF system, known as CAFE (Computer-Aided Fabrication Environment), has been implemented. So far this system provides an electronic personal notebook, machine instructions, and equipment status reports. Four fabrication facilities are being served, at least in part. Even though crude, CAFE has been in constant use. The requirements of a scheduling program are being studied. One surprising result so far is the importance of setup operations in scheduling some equipment. Two new process-simulation modules have been developed. One is for a focused ion beam operation used for implanting, and the other is for nonuniform oxidation. Improved models were inserted into the simulators SUPREM and MINIMOS. GRA

N86-31246# Stanford Univ., Calif. Systems Optimization Lab.
LSSOL (VERSION 1.0): A FORTRAN PACKAGE FOR CONSTRAINED LINEAR LEAST-SQUARES AND CONVEX QUADRATIC PROGRAMMING. USER'S GUIDE
Philip E. Gill, Sven J. Hammarling, Walter Murray, Michael A. Saunders, and Margaret H. Wright Jan. 1986 44 p
(Contracts N00014-85-K-0343; DAAG29-84-K-0156; DE-AA03-76SF-00326; DE-AS03-76ER-72018)
(AD-A166945; SOL-86-1) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report forms the user's guide for Version 1.0 of LSSOL, a set of Fortran 77 subroutines for linearly constrained linear least-squares and convex quadratic programming. The method of LSSOL is of the two-phase, active-set type, and is related to the method used in the package SOL/QPSOL. Two main features of LSSOL are its exploitation of convexity and treatment of singularity. LSSOL may also be used for linear programming, and to find a feasible point with respect to a set of linear inequality constraints. LSSOL treats all matrices as dense, and hence is not intended for large sparse problems. Author (GRA)

N86-31247# Sandia National Labs., Albuquerque, N. Mex.
SOFTWARE PROTECTION: MYTH OR REALITY
J. R. Gosler 1 Nov. 1985 15 p Presented at Crypto '85, Santa Barbara, Calif., 18 Aug. 1985
(Contract DE-AC04-76DP-00789)
(DE86-003719; SAND-85-1589C; CONF-8508152-1) Avail: NTIS HC A02/MF A01

Staggering amounts of commercial software are marketed to fulfill needs from the PC explosion. Unfortunately, such software is trivial to duplicate. From the vendors' viewpoint a way to protect profit is needed. Typically, they have resorted to various schemes that attempt to inhibit the duplication process. Although protection of future profit is important, so is protection against current loss. Commercial and business related software must be adequately protected least data be stolen or manipulated. However, more important than any of these classes is protection of government computer resources, especially classified and operational software and data. Loss of control in this realm could be detrimental to national security. This paper addresses current technologies employed in protection schemes: signatures (magnetic and physical) on floppy disks, Software Analysis Denial (SAD), Hardware Security Devices (HSD), and Technology Denial Concepts (TDC) are presented, with an emphasis on SAD. Advantages and disadvantages of these schemes will be clarified. DOE

N86-31248# Los Alamos National Lab., N. Mex.
LOS ALAMOS SOFTWARE DEVELOPMENT TOOLS
G. Cort and R. O. Nelson 1985 10 p Presented at the US DECUS Symposium, Anaheim, Calif., 9 Dec. 1985
(Contract W-7405-eng-36)
(DE86-006024; LA-UR-86-214; CONF-851264-4) Avail: NTIS HC A02/MF A01

We present the details of a strategy for acquiring a comprehensive set of software tools to support a life-cycle-based software development methodology. Specific criteria for evaluating software tools are presented with examples from the Los Alamos tool kit. The importance of an environment to support both the tools and the methodology is discussed. DOE

N86-31249# Sandia National Labs., Albuquerque, N. Mex.
SEMICONDUCTOR DEVICE MODELING ON A WORKSTATION
C. Diegert Sep. 1985 15 p Presented at the Workshop on Large Scale Computational Device Modeling, Chicago, Ill., 18 Apr. 1985
(Contract DE-AC04-76DP-00789)
(DE86-001125; SAND-85-0844; CONF-8504207-1) Avail: NTIS HC A02/MF A01

We choose to move from large mainframe computers to workstations to gain the interactive graphics we need to prepare and to analyze semiconductor device modeling problems. Given this much on a workstation, it is convenient to attempt to solve the entire problem there. We find that a top-of-the-line Apollo 660 workstation, with bit-slice processor, pipelined arithmetic processor, and 4 megabytes of real memory, is surprisingly effective in finding solutions when running the Pisces II device modeling code. In our experiment we find where the workstation bogs down when running these problems. We both analyze the Pisces CPU time log and we sample the executing program to accumulate a histogram of execution time as distributed over the source code. Results suggest how Pisces could be adapted to solve somewhat larger problems entirely on the workstation. Evolution of a trusted derivative of Pisces, to be used on supercomputers without interactivity, is suggested to complement our success with Pisces on workstations. DOE

N86-31250# Oak Ridge Gaseous Diffusion Plant, Tenn.
INTERPRETED MULTIPROCESS DISPLAY CONTROL SYSTEM
J. M. Heidle 1986 11 p Presented at the DECUS Symposium, Dallas, Tex., 27 Apr. 1986
(Contract DE-AC05-84OT-21400)
(DE86-008844; K/AIS-5004; CONF-860470-2) Avail: NTIS HC A02/MF A01

Designing a human-interface system for a large data acquisition and process control facility presented many challenges for the software development team. The design goal was to support many

classes of users who require simple coordination of multiple devices along with flexible representation and manipulation of real-time data. DOE

N86-31251# Oak Ridge Gaseous Diffusion Plant, Tenn. Computer-Aided Engineering.
IN-HOUSE CAD TRAINING: A REALISTIC APPROACH
Tony Whitus 10 Apr. 1986 11 p Presented at the American Institute for Design and Drafting Convention, Hollywood, Fla., 7 Apr. 1986
(Contract DE-AC05-84OT-21400)
(DE86-008926; K/D-5697; CONF-8604150-1) Avail: NTIS HC A02/MF A01

The need for industry to retrain its engineering personnel to use a CAD system can be demanding, as well as frustrating. In fact, the larger and more diverse the organization, the more demanding these requirements may be. It should be noted that in preparing for CAD implementation, the training needs and requirements are often underestimated. Additionally, most engineering organizations implementing CAD do not have personnel experienced in developing training programs or in teaching manipulative skills. This text describes the evolution of the in-house CADAM basic training program at Martin Marietta Energy Systems, Inc. Rather than emphasize the theoretical aspects of designing such a program, the paper will concentrate on the practical, more realistic aspects of program development. The paper should serve as a guide to others desiring to develop a similar program. This paper first presents a brief look at factors concerning retraining the experienced engineering employee. Then, the actual planning, organization, structuring, implementation, and evaluation of the training program, as well as possible future directions are presented. Finally, the paper offers advice to those planning similar in-house CAD training programs. DOE

N86-31252# Oak Ridge National Lab., Tenn.
USING SMF RECORDS IN MANAGING A CADAM SYSTEM
J. H. Rosser Feb. 1986 15 p Presented at the CADAM User's Exchange International Conference, Dallas, Tex., 3 Mar. 1986
(Contract DE-AC05-84OT-21400)
(DE86-006408; K/CSD/INF-85/24; CONF-860370-1) Avail: NTIS HC A02/MF A01

Computer-Aided Design (CAD) requires a larger commitment of resources within an organization. It is imperative that methods be developed and implemented which will aid in the efficient management of CAD systems. The purpose of this paper is to discuss one of the methods by which Martin Marietta Energy Systems is addressing these management problems using utilization data which are available from the CAD host computer. Also, to be examined are the integration of these data with related data in applications databases and their use for resource management, equipment management, human resource management, cost tracking, and productivity analysis. DOE

N86-31253# New York Univ., New York. Mathematics and Computing Lab.
HYPERCUBE ALGORITHMS AND IMPLEMENTATIONS
O. A. McBryan and E. F. VandeVelde Feb. 1986 118 p Presented at the 2nd Society for Industrial and Applied Mathematics Conference on Parallel Computing, Norfolk Va., 18 Nov. 1985
(Contract DE-AC02-76ER-03077)
(DE86-007439; DOE/ER-03077/271; CONF-8511169-1) Avail: NTIS HC A06/MF A01

Parallel algorithms are presented for important components of Computational Fluid Dynamics algorithms along with implementations on hypercube computers. Elliptic equations with 1.6 million unknowns and hyperbolic equations with 4 million unknowns have been solved using 128 processors. For elliptic equations, a parallel Preconditioned Conjugate Gradient method is described which has been used to solve pressure equations discretized with high-order finite elements on irregular grids. A parallel Full Multigrid Method and a parallel Fast Poisson Solver are also presented. Hyperbolic Conservation Laws have been discretized with parallel versions of finite difference methods and with the Random Choice Method. The performance of these algorithms is analyzed in terms of machine efficiency, communication time, bottlenecks and software development costs. A key aspect of this work is the development of a library of parallel operators for distributed vectors and matrices, efficient for both full and sparse data. The implementation of these operators on hypercubes is described along with measurements of communication effects. Using the library the PDE algorithms mentioned above have been implemented on both serial computers and on hypercubes without any code modification. All inter-process communication is hidden in library routines. A general parallel computer simulator is described along with its use in the development of the algorithms. DOE

N86-31254# Argonne National Lab., Ill.
FULLY PARALLEL ALGORITHM FOR THE SYMMETRIC EIGENVALUE PROBLEM
J. J. Dongarra and D. C. Sorensen Jan. 1986 25 p Presented at the 2nd Society for Industrial and Applied Mathematics Conference on Parallel Computing, Norfolk Va., 18 Nov. 1985
(Contracts W-31-109-eng-38; DE-AC05-84OR-21400; DE-FG02-85ER-25001)
(DE86-007553; ANL/MCS-TM-62; CONF-8511169-2) Avail: NTIS HC A02/MF A01

In this paper we present a parallel algorithm for the symmetric algebraic eigenvalue problem. The algorithm is based upon a divide and conquer scheme suggested by Cuppen for computing the eigensystem of a symmetric tridiagonal matrix. We extend this idea to obtain a parallel algorithm that retains a number of active parallel processes that is greater than or equal to the initial number throughout the course of the computation. The algorithm does not suffer from loss of parallelism associated with a typical divide and conquer dependency graph. We give a new deflation technique which together with a robust root finding technique will assure computation of an eigensystem to full accuracy in the residuals and in the orthogonality of eigenvectors. A brief analysis of the numerical properties and sensitivity to round off error is presented to indicate where numerical difficulties may occur. We also suggest a way to combine the tridiagonal method with a parallelization of the initial reduction to tridiagonal form to obtain a fully parallel algorithm for the symmetric eigenvalue problems. The algorithm is able to exploit parallelism at all levels of the computation and is well suited to a variety of architectures. We also touch upon implementation and portability issues with particular attention paid to the role of the algorithm as a library subroutine. We discuss a technique used to implement the algorithm which allows the code to be transported to a significant variety of existing parallel computers. Computational results are presented for several machines to demonstrate this. These results are very encouraging with respect to both accuracy and speedup. A surprising result is that the parallel algorithm, even when run in serial mode, can be significantly faster than the best sequential algorithm on large problems, and is effective on moderate size problems when run in serial mode. DOE

N86-31255# Argonne National Lab., Ill.
USER GUIDE FOR JAKEF, REVISION 1
K. E. Hillstrom Dec. 1985 33 p
(Contract W-31-109-eng-38)
(DE86-007554; ANL/MCS-TM-16-Rev-1) Avail: NTIS HC A03/MF A01

JAKEF is a language processor that accepts as input a single precision or double precision FORTRAN subroutine defining an objective function f(x) or a vector function F(x) and produces as output a single precision or double precision FORTRAN subroutine defining the gradient of f(x) or the Jacobian of F(x). JAKEF accepts as input ANSI 1977 standard FORTRAN subroutines and produces as output ANSI 1977 FORTRAN subroutines. JAKEF itself is written in ANSI 1977 standard FORTRAN, except for the use of an extended character set and transfers of control into an IF-block from outside the IF-block. This report serves as a user guide for the processor. DOE

N86-31256# Stanford Univ., Calif. Systems Optimization Lab.
FORTRAN PACKAGE FOR CONSTRAINED LINEAR LEAST-SQUARES AND CONVEX QUADRATIC PROGRAMMING. USER'S GUIDE FOR LSSOL (VERSION 1.0)
P. E. Gill, S. J. Hammarling, W. Murray, M. A. Saunders, and M. H. Wright Jan. 1986 44 p
(Contract DE-AS03-76ER-72018)
(DE86-009083; DOE/ER-72018/T22) Avail: NTIS HC A03/MF A01

This report forms the user's guide for Version 1.0 of LSSOL, a set of Fortran 77 subroutines for linearly constrained linear least-squares and convex quadratic programming. The method of LSSOL is of the two-phase, active-set type, and is related to the method used in the package SOL/QPSOL. Two main features of LSSOL are its exploitation of convexity and treatment of singularity. LSSOL may also be used for linear programming, and to find a feasible point with respect to a set of linear inequality constraints. LSSOL treats all matrices as dense, and hence is not intended for large sparse problems. DOE

N86-31257# Allied Bendix Corp., Kansas City, Mo.
CAD-CAM DATA EXCHANGE PILOT PROJECT
J. Hintz and D. Williams Mar. 1986 30 p
(Contract DE-AC04-76DP-00613)
(DE86-009128; BDX-613-3418) Avail: NTIS HC A03/MF A01

CAD-CAM data were exchanged between dissimilar CAD systems and the information was used to fabricate three parts. Problems were identified and solutions were proposed or implemented in the area of translation methods, data verification, CAD drawing conventions, and data handling. Additional software needed for productive data exchange has been identified. DOE

N86-31258# European Organization for Nuclear Research, Geneva (Switzerland).
PASCAL FOR ENGINEERS: A COURSE INCLUDING OMEGASOF PASCAL FOR MICROCOMPUTERS
L. A. Tausch 16 Sep. 1985 133 p
(DE86-701701; CERN-85-14) Avail: NTIS (US Sales Only) HC A07/MF A01

These are the notes of a PASCAL course for controls engineers at CERN. The course starts with Standard Pascal and includes OMEGASOFT Pascal, a powerful extension of Pascal towards real-time and systems applications. It demonstrates how a language such as Pascal, with adequate extensions for systems programming and embedded microprocessor-driven systems, can substantially increase the productivity of programmers and the reliability of their products. Also enhanced will be the legibility of the programs and their maintainability, since programming in Pascal automatically leads to autodocumentation. Simple examples show how OMEGASOFT-PASCAL can be used for efficient programming of embedded systems for real-time data acquisition and control using the MC6809 microprocessor. DOE

N86-31259# Oak Ridge National Lab., Tenn.
DEVELOPMENT AND EVALUATION OF DOTTOR, A COMPUTER CODE TO COUPLE TWO-DIMENSIONAL TO THREE-DIMENSIONAL DISCRETE ORDINATES CALCULATIONS
J. L. Thompson, M. B. Emmett, and H. L. Dodds, Jr. Apr. 1986 83 p
(Contract DE-AC05-84OR-21400)
(DE86-010081; ORNL/TM-9919) Avail: NTIS HC A05/MF A01

A method has been developed to couple two-dimensional (d-D) to three-dimensional (3-D) discrete ordinates transport calculations. This method is useful for problems in which a 3-D Cartesian (X-Y-Z geometry) region of interest is very far from a point source. A 3-D solution from the source including the region of interest is prohibited due to the large computing cost of such calculations. The problem is solved by first performing a 2-D discrete ordinates calculation from the source past the region of interest. The results of the 2-D calculations are transformed into a boundary condition on the surface of the 3-D region of interest. This transformation or coupling method is developed and implemented in the DOTTOR computer code. The boundary condition is then used for a subsequent 3-D discrete ordinates calculation in the region of interest. Simple test problems were used to evaluate the accuracy and speed (i.e., computing cost) of the DOTTOR code. The evaluation indicates that the DOTTOR code produces accurate results with acceptable computing costs. The algorithm chosen showed a significant speed advantage over others tested when applied to large problems. DOE

N86-31260*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONFIDENCE ELLIPSE RESEARCH SOFTWARE (EAAF) Final Report
Janet Myhre, Will Duquette, and Daniel Hockman 8 Aug. 1985 48 p Prepared in cooperation with Mathematical AnalysisResearch Corp., Claremont, Calif.
(Contract NAS7-918)
(NASA-CR-176983; JPL-D-2786; NAS 1.26:176983; AD-A166479; TM-6) Avail: NTIS HC A03/MF A01 CSCL 09/2

This document describes three programs used by MARC in studying and testing confidence ellipses. Genellipse is an ellipse graphing and combination program. It allows the user to specify up to twenty confidence ellipses, combine ellipses, graph ellipses, and test ellipses for combination. It has been used primarily to explore the geometric properties of the combination method, but has also been used to create figures for a number of other reports. Ellsim is a 'confidence ellipse simulation' program. It has been used to explore the robustness and properties of the statistical test (which is used to decide whether or not to combine two ellipses). In it, two normal data distributions are specified, corresponding to two emitters. Confidence ellipses are generated, tested, and combined, and various descriptive statistics are compiled. In addition, there is a routine to calculate the power of the statistical test in certain cases. Ellipstuff is an 'ellipse routine library,' which contains a large number of routines to make working with ellipses easier. As such, both Genellipse and Ellsim contain all these routines, but they are all listed separately. If more programs need to be written, these are the routines on which to build. They contain all of these routines, but they are also listed separately. If more programs need to be written, these are the routines to build them with. GRA

N86-31411*# Houston Univ., Tex. Dept. of Mechanical Engineering.
DESIGN CRITERIA FOR EXPERT SYSTEMS
Robert Allen *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 12 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 09B

N86-31429*# McNeese State Univ., Lake Charles, La. Dept. of Electrical Engineerig.
AUTOMATION OF REVIEW/APPROVAL CYCLE OF MCAUTO CAD/CAM GENERATED DRAWINGS AND DOCUMENTS
Howard S. Minn *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 17 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 09B

N86-31432*# Missouri Univ., St. Louis. Dept. of Computer Science.
INTEGRATION OF AN EXPERT SYSTEM INTO A USER INTERFACE LANGUAGE DEMONSTRATION
Daniel C. StClair *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 47 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks.

N86-31261*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OPTIMAL PARTITIONING OF RANDOM PROGRAMS ACROSS TWO PROCESSORS Final Report
David M. Nicol Aug. 1986 27 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178159; ICASE-86-53; NAS 1.26:178159) Avail: NTIS HC A03/MF A01 CSCL 09B

The optimal partitioning of random distributed programs is discussed. It is concluded that the optimal partitioning of a homogeneous random program over a homogeneous distributed system either assigns all modules to a single processor, or distributes the modules as evenly as possible among all processors. The analysis rests heavily on the approximation which equates the expected maximum of a set of independent random variables with the set's maximum expectation. The results are strengthened by providing an approximation-free proof of this result for two processors under general conditions on the module execution time distribution. It is also shown that use of this approximation causes two of the previous central results to be false. Author

N86-31262# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
BROADCASTING TOPOLOGY AND ROUTING INFORMATION IN COMPUTER NETWORKS
John M. Spinelli Mar. 1986 16 p
(Contract N00014-84-K-0357; DARPA Order-3045)
(AD-A166663; AD-E500758; LIDS-P-1543) Avail: NTIS HC A02/MF A01 CSCL 09/2

An efficient algorithm is presented which allows each node in a computer network to maintain a correct view of the network topology despite link and node failures. Reliability is achieved without transmitting any information other than the operational status of links. Messages are only sent in response to topological changes: periodic retransmission is not required. The algorithm is extended to allow nodes to maintain congestion measurements used in making routing decisions. Author (GRA)

N86-31263# Purdue Univ., West Lafayette, Ind.
TOPOLOGICAL PROPERTIES OF INTERCONNECTION NETWORKS FOR PARALLEL PROCESSORS. A UNIFIED APPROACH, APPENDIX E Ph.D. Thesis
Robert R. Seban Dec. 1985 271 p
(Contract DAAG29-82-K-0101; Grant NSF ECS-81-20896)
(AD-A167336; ARO-18790.17-EL-App-E) Avail: NTIS HC A12/MF A01 CSCL 09/2

Two methods are used to speed up the execution of a computational task. One is new technology development and the other is the exploitation of parallelism in the computation. To take an advantage of the parallelism in a task requires the utilization of parallel computer architectures. At a certain high level of abstraction a parallel computer system is represented as a graph where the nodes represent processors, memories, or other devices, and the edges represent the communication links. In this thesis the following problems of parallel processing are studied. First is a theoretical study of topological properties of interconnection networks. Second is a case study of a network design for a real-time system. Lastly, the use of SIMD(Single Instruction Stream Multiple Data Stream) networks for performing shuffles is discussed. A general model that can be used to describe networks and systems with arbitrary topologies is developed. Based upon the morphism of groups, the concept of morphism of systems is developed. The morphism of systems is called quasimorphism and allows a method of comparison between topologically arbitrary parallel computer systems. The quasimorphism is used to study the emulation of one system by another. GRA

N86-31264# Australian National Univ., Canberra. Plasma Research Lab.
NETWORK APPROACH TO LARGE-SCALE EXPERIMENTAL DATA ACQUISITION AND ANALYSIS
M. A. Corbould and J. A. How 1984 20 p
(DE86-701200; ANU-PRL-84/4) Avail: NTIS (US Sales Only) HC A02/MF A01

The Plasma Research Laboratory at the Australian National University has developed a sophisticated and flexible data acquisition system for its LT-4 tokamak that requires very little support to construct, maintain, and expand. It is novel in that is based on a minicomputer network and is built almost entirely of commercially available products. Benchmarks show that the network system outperforms conventional stand-alone and time-shared data systems. DOE

N86-31417*# City Univ. of New York, N.Y. Bronx Community Coll.
INVESTIGATION OF LOCAL AREA NETWORKS FOR AN OBITING SPACE STATION Final Report
Louis A. DeAcetis *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 4 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 09B

63 CYBERNETICS

Includes feedback and control theory.
For related information see also *54 Man/System Technology and Life Support.*

N86-31265*# Toledo Univ., Ohio. Dept. of Electrical Engineering.
CONTROL DESIGN FOR ROBUST STABILITY IN LINEAR REGULATORS: APPLICATION TO AEROSPACE FLIGHT CONTROL Final Report, 1 Jun 1985 - 17 Jul. 1986
Rama K. Yedavalli 1986 63 p
(Grant NAG1-578)
(NASA-CR-176858; NAS 1.26:176858) Avail: NTIS HC A04/MF A01 CSCL 09B

Time domain stability robustness analysis and design for linear multivariable uncertain systems with bounded uncertainties is the central theme of the research. After reviewing the recently developed upper bounds on the linear elemental (structured), time varying perturbation of an asymptotically stable linear time invariant regulator, it is shown that it is possible to further improve these bounds by employing state transformations. Then introducing a quantitative measure called the stability robustness index, a state feedback conrol design algorithm is presented for a general linear regulator problem and then specialized to the case of modal systems as well as matched systems. The extension of the algorithm to stochastic systems with Kalman filter as the state estimator is presented. Finally an algorithm for robust dynamic compensator design is presented using Parameter Optimization (PO) procedure. Applications in a aircraft control and flexible structure control are presented along with a comparison with other existing methods. Author

N86-31266# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
THE COMPUTATIONAL COMPLEXITY OF TWO-LEVEL MORPHOLOGY
G. Edward Barton, Jr. Nov. 1985 39 p Presented at the Workshop on Finite-State Morphology, Stanford, Calif., 29-30 Jul. 1985
(Contract N00014-80-C-0505)
(AD-A165991; AI-M-856) Avail: NTIS HC A03/MF A01 CSCL 05/7

Morphological analysis requires knowledge of the stems, affixes, combinatory patterns, and spelling-change processes of a natural language. The computational difficulty of the task can be clarified by investigating the computational characteristics of specific models of morphological processing. The use of finite-state

machinery in the two-level model by Kimmo Kosken-niemi gives it the appearance of computational efficiency, but closer examination shows the model does not guarantee efficient processing. Reductions of the satisfiability problem show that finding the proper lexical-surface correspondence in a two-level generation or recognition problem can be computationally difficult. However, another source of complexity in the existing algorithms can be sharply reduced by changing the implementation of the dictionary component. A merged dictionary with bit-vectors reduces the numbers of choices among alternative dictionary subdivisions by allowing several subdivisions to be searched at once.
Author (GRA)

N86-31267# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
APPLICATION OF YBJ (YOULA, BONGIORNO AND JABR) CONTROL THEORY TO THE INITIAL RESPONSE PROBLEM M.S. Thesis
Paul J. Warden May 1986 110 p
(AD-A166756; AFIT/CI/NR-86-46T) Avail: NTIS HC A06/MF A01 CSCL 09/3

In this thesis, two theorems were derived. First, the Initial Response Theorem describes the necessary and sufficient conditions for a series compensator for a feedback control system to simultaneously stabilize the system and cause the initial system response to achieve prescribed constraints. A single input-single output, continuous time linear system is considered, with a delta function driving any rational transfer function in the s-domain being the system input. Design constraints can be placed on the initial response value, and on any of the derivatives (from the right) of the initial response. Second, the Initial Response Parameterization gives a parameterization of the complete set of compensators that will meet the given constraints whenever the conditions of the Initial Response Theorem are met. The area of Youla, Bongiorno and Jabr (YBJ) Control Theory was used for the derivations, but first required a system transformation to convert the initial value problem to one of stability. Author (GRA)

N86-31268# Brown Univ., Providence, R. I. Center for Dynamical Systems.
FILTERING AND CONTROL FOR WIDE BANDWIDTH NOISE DRIVEN SYSTEMS Interim Report
H. J. Kushner and W. Runggaldier Jan. 1986 60 p
(Contracts DAAG29-84-K-0082; N00014-83-K-0542; DA Proj. 230-4; Grant AF-AFOSR-0116-81)
(AD-A166964; LCDS-86-8; AFOSR-86-0258TR) Avail: NTIS HC A04/MF A01 CSCL 09/2

Much of modern stochastic control theory uses ideal white noise driven models (Ito equations). If the observed data is corrupted by noise, then the noise is usually assumed to be white Gaussian. Typically, if the underlying models are linear, one uses a Kalman-Bucy filter to get an estimate of the state, and then bases the control on this estimate. In practice, the noises are rarely white, and the reference signals and the systems are only approximations in some sense to a diffusion. Never-the-less, owing to lack of viable alternatives, one still uses the Kalman-Bucy filter, etc. Then the estimates are not optimal and, indeed, might be quite far from being optimal, and similarly for the corresponding control. (Examples are given to illustrate this.) The sense in which the estimates and/or control is useful need to be examined in order to justify the use of the commonly used procedure. The issue is much deeper than mere robustness in the usual sense, since basic questions of interpretation of the results are involved. The paper deals with these questions. For the filtering problem where the signal is a near Gauss-Markov process and the observation noise wide band, it is shown that the usual method is nearly optimal with respect to a class of alternative data processors. This alternative class is rather natural and includes the data processors which one would normally want to use. GRA

N86-31269# Los Alamos National Lab., N. Mex.
INTELLIGENT INTERFACE FOR DESIGN AND SIMULATION
W. Draisin and E. Peter 1986 8 p Presented at the Expert Database Systems Conference, Charleston, S.C., 1 Apr. 1986
(Contract W-7405-eng-36)
(DE86-000762; LA-UR-3275; CONF-860458-1) Avail: NTIS HC A02/MF A01

We are developing a system composed of intelligent interfaces, expert systems, and databases that uses artificial intelligence techniques to simplify the use of large simulation codes and to help design complicated physical devices. The simulation codes are used in analyzing and designing weapons, and the devices are themselves parts of weapon systems. From a designer's point of view, the simulation process is the same no matter what is being simulated. In the course of developing two intelligent interfaces for the design of nuclear weapons, we have found that data-driven programming is a useful technique for implementing an open-ended user interface to assist the designer. We discuss the simulation process as it is done now and as it could be done with intelligent interfaces. We then discuss the use of data-driven programming in a database environment to support an interface for an arbitrary number of simulation codes. DOE

N86-31270# Argonne National Lab., Ill.
AUTOMATED REASONING: BASIC RESEARCH PROBLEMS
L. Wos Mar. 1986 40 p
(Contract W-31-109-eng-38)
(DE86-009214; ANL/MCS-TM-67) Avail: NTIS HC A03/MF A01

In this paper, we present some of the open research problems in the field of automated reasoning. By collecting these problems in one place, we intend to stimulate research and thus reduce the time required to reach one of the primary objectives of the field. That objective is to design and implement a computer program that functions as a high-level automated reasoning assistant. This paper is intended for new researchers as well as those who have been active in the field. We therefore include an overview of automated reasoning itself, touching on the basic elements, various examples and some of its applications. The existence of single automated reasoning programs that have provided valuable assistance in answering open questions in mathematics and logic, designing superior circuits, validating existing circuit designs, and proving properties of computer programs establishes the usefulness and versatility of such programs. The degree of assistance future automated reasoning programs will offer depends on which of the open problems cited in this paper are solved. DOE

N86-31271# Oak Ridge National Lab., Tenn.
REAL-TIME PRODUCTION SYSTEM FOR INTELLIGENT ROBOT CONTROL
G. deSaussure, D. Kammer, and C. R. Weisbin 1986 13 p Presented at the National Conference on Artificial Intelligence, Philadelphia, Pa., 11 Aug. 1986
(Contract DE-AC05-84OR-21400)
(DE86-008501; CONF-860848-1) Avail: NTIS HC A02/MF A01

The use of a production system for the control of an autonomous robot presents several attractive features: the explicitness and homogeneity of the knowledge representation facilitates explaining, verifying and modifying the rules which determine the robot's behavior; it also permits the intremental extension of the domain of competence. However, real-time operation poses a number of challenges due to the dynamic nature of the data and because the system must frequently deal with a large knowledge base in a limited time. An implementation of a knowledge base is discussed where a large commercial real-time expert system originally designed for industrial process diagnostic was adapted to the control of an autonomous mobile robot planning, executing and monitoring a set of navigational tasks. DOE

N86-31272# Grenoble-1 Univ. (France). Lab. de Mathematiques Appliquees.
OPTIMUM PARAMETER IDENTIFICATION IN A DYNAMIC SYSTEM DESCRIBED BY A STOCHASTIC LINEAR DIFFERENTIAL EQUATION WITH CONTROL FUNCTIONS Ph.D. Thesis [IDENTIFICATION OPTIMALE DES PARAMETRES D'UN SYSTEME DYNAMIQUE REGI PAR UNE EQUATION DIFFERENTIELLE STOCHASTIQUE LINEAIRE COMMANDEE]

Nadia Brahimi 1985 140 p In FRENCH
(ESA-86-97280) Avail: NTIS HC A07/MF A01

The estimation of parameters along a system variation in a given time interval for a chosen strategy and the determination of the optimal control in the sense of obtaining criteria linked to the Fisher information matrix to improve the quality of the estimation are considered. Discrete time and continuous time strategies are studied. In the first case the Girsanov theorem justifies the Markov chain approach. It is shown that the maximum likelihood estimator is consistent with a normal asymptotic function. The continuous case is treated by approximations given by the limits of series of processes. The second problem remains unsolved. The reasons are discussed. ESA

N86-30648# London Univ. (England). Dept. of Aeronautical Engineering.
FINITE STATE MODELLING OF AEROELASTIC SYSTEMS FOR ACTIVE CONTROL APPLICATIONS: A GENERAL THEORY
Ranjan Vepa *In* DGLR The 2nd International Symposium on Aeroelasticity and Structural Dynamics 1985 p 309-319 (For primary document see N86-30627 22-01)
Avail: NTIS HC A99/MF E03

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N86-31273*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
METHODS FOR THE IDENTIFICATION OF MATERIAL PARAMETERS IN DISTRIBUTED MODELS FOR FLEXIBLE STRUCTURES Final Report
H. T. Banks, J. M. Crowley, and I. G. Rosen May 1986 61 p Submitted for publication
(Contracts NAS1-16394; NAS1-17130)
(NASA-CR-178135; NAS 1.26:178135; ICASE-84-66) Avail: NTIS HC A04/MF A01 CSCL 12A

Theoretical and numerical results are presented for inverse problems involving estimation of spatially varying parameters such as stiffness and damping in distributed models for elastic structures such as Euler-Bernoulli beams. An outline of algorithms used and a summary of computational experiences are presented. Author

N86-31274# Technische Hogeschool, Eindhoven (Netherlands). Measurement and Control Group.
SYSTEM IDENTIFICATION. MINI COURSE
P. Eykhoff and A. J. W. vandenBoom Jul. 1984 39 p Mini course held in Eindhoven, Netherlands, Jul. 1984
(ER-84/02; ESA-86-97522) Avail: NTIS HC A03/MF A01

The coherence among system identification methods is discussed. A generalized diagram for various parameter estimation methods is presented. The coherence in pseudo-linear regression schemes is considered. For individual titles, see N86-31275 through N86-31276. ESA

N86-31275# Technische Hogeschool, Eindhoven (Netherlands).
ON THE COHERENCE AMONG THE MULTITUDE OF SYSTEM IDENTIFICATION METHODS **c65**
P. Eykhoff and A. J. W. vandenBoom *In its* System Identification. Mini Course Jul. 1984 p 3-24 Presented at 6th IFAC Symposium on Identification and System Parameter Estimation, Washington, 1982 (For primary document see N86-31274 22-64)
Avail: NTIS HC A03/MF A01

The choice of template functions/series that span function spaces of process input-output in system identification is discussed. Based on the template functions/series choice, estimation methods, as well as their properties, can be split into three classes, depending on whether the template functions and observations are deterministic or stochastic. Depending on the class to which they belong, the properties of the estimators range from complete statistical information to only limit-measures for the estimation accuracy attainable. The Cramer-Rao relation and the information matrix play an essential role. Linearity, pseudo-linearity and nonlinearity-in-the-parameters of the models used are related to such fundamental aspects. ESA

N86-31276# Technische Hogeschool, Eindhoven (Netherlands).
A GENERALIZED DIAGRAM FOR VARIOUS PARAMETER ESTIMATION METHODS; THE COHERENCE IN PSEUDO-LINEAR REGRESSION SCHEMES **c65**
P. Eykhoff and A. J. W. vandenBoom *In its* System Identification. Mini Course Jul. 1984 p 25-37 (For primary document see N86-31274 22-64)
Avail: NTIS HC A03/MF A01

The relationships between recursive estimation schemes for single-input single-output systems are established by presenting a general diagram of which the least squares, generalized least squares, extended matrix, instrumental variable, approximated maximum likelihood, implicit quasilinearization, filtered instrumental variable estimation, (sub) optimal instrumental variable, and the instrumental variable variant of the extended matrix method estimators are special cases. In the diagram, three operations can be distinguished: noise filtering; model extension; and instrumental variable generation. It is shown that by proper combination of these three main operations, all the estimators mentioned can be constructed. ESA

N86-31277# Pittsburgh Univ., Pa. Inst. for Computational Mathematics and Application.
PARALLEL SOLUTION OF LINEAR SYSTEMS WITH STRIPED SPARSE MATRICES. PART 1. VLSI NETWORKS FOR STRIPED MATRICES
Rami Melhem Jan. 1986 50 p
(Contract N00014-85-K-0339)
(AD-A166046; ICMA-86-91-Pt-1) Avail: NTIS HC A03/MF A01 CSCL 12/1

The multiplication of a matrix by a vector and the solution of triangular linear systems are the most demanding operations in the majority of iterative techniques for the solution of linear systems. Data-driven VLSI networks that perform these two operations efficiently for sparse matrices are introduced. In order to avoid computations that involve zero operands, the non-zero elements in a sparse matrix are organized in the form of non intersecting stripes, and only the elements within the stripe structure of the matrix are manipulated. Detailed analysis of the networks proves that both operations may be completed in n global cycles with minimal communication overhead, where n is the order of the linear system. The number of cells in each network as well as the communication overhead are determined by the stripe structure of the matrix. A companion paper examines this structure for the class of sparse matrices generated in Finite Element Analysis.
Author (GRA)

N86-31278# Pittsburgh Univ., Pa. Inst. for Computational Mathematics and Application.
PARALLEL SOLUTION OF LINEAR SYSTEMS WITH STRIPED SPARSE MATRICES. PART 2. STIFFNESS MATRICES, A CASE STUDY
Rami Melhem Jan. 1986 34 p
(Contract N00014-85-K-0339)
(AD-A166047; ICMA-86-92-Pt-2) Avail: NTIS HC A03/MF A01 CSCL 12/1

The stripe structures of stiffness matrices resulting from irregular domains covered by regular grids are analysed. It is proved that the non-zero elements in these matrices may be covered by very few stripes, and that these stripes may be non-overlapping, if the nodes of the grids are numbered appropriatly. The exact number of stripes, which is independent of the size of the problem, is derived for different types of grids and different numbering schemes. The stripe structure of some irregular grids are also examined. GRA

N86-31279# Washington Univ., St. Louis, Mo. Dept. of Systems Science and Mathematics.

DEVELOPMENT AND APPLICATION OF THE P-VERSION OF THE FINITE ELEMENT METHOD Annual Report, 30 Sep. 1984 - 29 Sep. 1985
I. Norman Katz 21 Nov. 1985 35 p
(Grant AF-AFOSR-0315-82)
(AD-A166056; AFOSR-86-0087TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

The p-version of the finite element method is a new, important, computationally efficient, approach to finite element analysis. It is more robust than the conventional h-version and its rate of convergence, for domains with corners and for other singularity problems, is twice that of the h-version. Hierarchic elements which implement the p-version efficiently have been formulated so as to enforce C(0) or C(1) continuity in the planar case, and so as to enforce C(0) continuity in three dimensions. GRA

N86-31280# Maryland Univ., College Park. Dept. of Computer Science.
ON USING MULTIPLE INVERTED TREES FOR PARALLEL UPDATING OF GRAPH PROPERTIES
Shaunak Pawagi and I. V. Ramakrishnan May 1985 28 p
(Contracts N00014-84-K-0530; F49620-83-C-0082; Grant NSF ECS-84-04399)
(AD-A166058; CAR-TR-124; CS-TR-1502; AFOSR-86-0045TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

Fast parallel algorithms are presented for updating the distance matrix, shortest paths for all pairs and biconnected components for an undirected graph and the topological ordering of vertices of a directed acyclic graph when an incremental change has been made to the graph. The kinds of changes that are considered here include insertion of a vertex of insertion and deletion of an edge or a change in the weight of an edge. The machine model used is a parallel random access machine which allows simultaneous reads but prohibits simultaneous writes into the same memory location. The algorithms described in this paper require O(log n) time and use 0(N-cubed) processors. These algorithms are efficient when compared to previously known 0(log-squared of n) time start-over algorithms for initial computation of the above mentioned properties of graphs. The previous solution is maintained in multiple inverted trees (a rooted tree where a child node points toward its parent) and after a minor change the new solution is rapidly recomputed from these trees. GRA

N86-31281# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
PERFORMANCE OF DISCRETE-TIME PREDICTORS OF CONTINUOUS-TIME STATIONARY PROCESSES Technical Report, Sep. 1985 - Aug. 1986
Stamatis Cambanis and Elias Masry Dec. 1985 52 p
(Contracts F49620-85-C-0144; N00014-84-K-0042)
(AD-A166231; TR-123; AFOSR-86-0013TR) Avail: NTIS HC A04/MF A01 CSCL 12/1

This document studies the asymptotic performance of linear predictors of continuous-time stationary processes from observations at n sampling instants on a fixed observation interval. Considered are both optimal and simpler choices of predictor coefficients; uniform sampling, as well as nonuniform sampling tailored to the statistics of the process under prediction. The authors concentrate on stationary processes with rational spectral densities and obtain the asymptotic performance for cases with no and with one quadratic-mean derivative. The analytical results are supplemented by numerical examples depicting small and large sample size performance. Author (GRA)

N86-31282# Vanderbilt Univ., Nashville, Tenn. Dept. of Mathematics.
MATCHING EXTENSION AND THE GENUS OF A GRAPH
Michael D. Plummer Mar. 1986 38 p
(Contract N00014-85-K-0488)
(AD-A166562) Avail: NTIS HC A03/MF A01 CSCL 12/1

Let G be a graph with p points having a perfect matching and suppose n is a positive integer with $n < or = (p-2)/2$. Then G is n-extendable if every matching in G containing n lines is a subset of a perfect matching. In this paper we obtain an upper bound on the n-extendability of a graph in terms of its genus. Author (GRA)

N86-31283# Stanford Univ., Calif. Lab. for Computational Statistics.
BIASED AND UNBIASED CROSS-VALIDATION IN DENSITY ESTIMATION
David W. Scott and George R. Terrell Apr. 1986 52 p
(Contracts N00014-85-K-0100; DAAG29-85-K-0212; N00014-83-K-0472; Grant N00014-83-G-0121)
(AD-A166905; LCS-TR-23) Avail: NTIS HC A04/MF A01 CSCL 12/1

Nonparametric density estimation requires the specification of smoothing parameters. The demands of statistical objectivity make it highly desirable to base the choice on properties of the data set. This paper introduces some biased cross-validation criteria for selection of smoothing parameters for kernel and histogram density estimators. These criteria are obtained by estimating L sub 2-norms of derivatives of the unknown density and provide slightly biased estimates of the average squared-L sub 2 error or mean integrated squared error. These criteria are roughly the analog of the generalized cross-validation procedure for orthogonal series density estimators. The authors present the relationship of the biased cross-validation procedure to the least squares cross-validation procedure, which provides unbiased estimates of the mean integrated squared error. Both methods are shown to be based on U-statistics. The two methods are compared through theoretical calculation of the noise in the cross-validation functions and corresponding cross validated smoothing parameters, by Monte Carlo simulation, and by example. Surprisingly large gains in asymptotic efficiency are observed between biased and unbiased cross-validation when the underlying density is sufficiently smooth. Reliability of cross-validation for finite samples is discussed. GRA

N86-31284# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mec
OPTIMUM ACCELERATION FACTORS FOR ITERATIVE SOLUTIONS OF LINEAR AND NON-LINEAR SYSTEMS Final Report, 1 Dec. 1984 - 30 Nov. 1985
George S. Dulikravich and David M. Young, Jr. 30 Dec. 1985 47 p
(Grant AF-AFOSR-0052-85)
(AD-A167171; AFOSR-86-0221TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

Two different approaches to the acceleration of iterative algorithms for the numerical solution of differential systems have been developed. General form of the non-linear minimal residual method has been analytically determined and numerically confirmed for solving linear and non-linear problems. The method was applied to multi-step algorithms for effectively determining optimal values of each of the acceleration parameters at each time step. It was found that both the rate of iterative convergence and the smoothness of the iterative convergence can be substantially augmented by the use of these multiple optimal acceleration parameters. The second approach involves a composite adaptive method which is based on variational techniques. An automatic procedure for determining splitting parameters needed in the iterative solution of large sparse linear systems was developed. It was then complemented with the generalized conjugate gradient acceleration procedures and successfully applied in the symmetric successive overrelaxation method and in the shifted incomplete Cholesky method. GRA

N86-31285# Pittsburgh Univ., Pa. Center for Multivariate Analysis.
EXTREME POINT METHODS IN THE DETERMINATION OF THE STRUCTURE OF A CLASS OF BIVARIATE DISTRIBUTIONS AND SOME APPLICATIONS TO CONTINGENCY TABLES
M. B. Rao, P. R. Krishnaiah, and K. Subramanyam Jan. 1986 32 p
(Contract F49620-85-C-0008)
(AD-A167230; TR-86-01; AFOSR-86-0254TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

A decomposition of the class of all bivariate positive quadrant dependent distribution into compact convex subsets is obtained. Extreme points of these compact convex subsets are investigated. A similar decomposition works out for the class of all bivariate distributions. Extreme points of the compact convex sets figuring in this decomposition are analyzed. An application to contingency tables is presented. GRA

N86-31286# Rockwell International Corp., Richland, Wash. Rockwell Hanford Operations.
UNIQUE SOLUTION TO A NONLINEAR ORDINARY DIFFERENTIAL EQUATION
Niall W. Kline (Boeing Computer Services Co., Richland, Wash.) Dec. 1985 13 p
(Contract DE-AC06-77RL-01030)
(DE86-005236; RHO-BW-SA-479-P) Avail: NTIS HC A02/MF A01

Numerous approaches have been employed in solving the equation governing unsteady conduction of heat along the radius of an annular cross section. One such method is described by Ozisik, in the spatial propagation of temperature is approximated by an elementary function of the penetration distance of a limiting quantity of heat. This method reduces the original problem, solving a partial differential equation for a function of two independent variables, to that of solving an ordinary differential equation for the approximate penetration distance as a function of time. Of interest here is the solution to the equation for penetration distance when, instead of heat conduction, the approximation method is applied to radial diffusion of decaying mass. DOE

N86-31287# Central Inst. of Physics, Bucharest (Rumania).
PIECEWISE ANALYTICAL PERTURBATION SERIES METHODS FOR SOLVING LINEAR ORDINARY DIFFERENT EQUATION. PART 1: GENERAL SCHEMES FOR ALGORITHM IMPLEMENTATION
Gh. Adam Dec. 1984 44 p
(DE86-700605; IFIN-FT-256-1984-Pt-1) Avail: NTIS (US Sales Only) HC A03/MF A01

The piecewise analytical perturbation series (PAPS) approach to the solution of linear ordinary differential equations is shown to provide both PAPS algorithms and equations for the accumulated discretization errors, each of which involving the same set of propagators, a property which is very important for the implementation of PAPS codes with global control over the discretization error. Finite, simple and flexible PAPS algorithms can be derived provided the coefficients of the given differential equation are approximated by truncated piecewise Legendre series. Theoretical realization of such algorithms are outlined and their orders of accuracy are established. DOE

N86-31288# Illinois Univ., Urbana. Dept. of Computer Science.
POTENTIAL FOR PARALLELISM IN ORDINARY DIFFERENTIAL EQUATIONS
C. W. Gear Feb. 1986 19 p Presented at the 2d International Conference on Computational Mathematics, Benin City, Nigeria, 1 Jan. 1986
(Contract DE-AC02-76ER-02383)
(DE86-007594; UIUCDCS-R-86-1246; UILU-ENG-86-1705; COO-2383-0115; CONF-860154-1) Avail: NTIS HC A02/MF A01

In this paper we are concerned with initial value problems. Techniques for boundary value problems (with the exception of shooting methods) are sufficiently different to those for initial value problems that the parallel techniques and impediments discussed in this paper are inapplicable to boundary value problems. DOE

N86-31289# Sandia National Labs., Albuquerque, N. Mex.
CELLULAR AUTOMATA METHOD FOR PHASE UNWRAPPING
D. C. Ghiglia and G. A. Mastin Oct. 1985 5 p Presented at the Topical Meeting on Signal Recovery and Synthesis, Honolulu, Hawaii, 2 Apr. 1986
(Contract DE-AC04-76DP-00789)
(DE86-002124; SAND-85-2323C; CONF-860457-1) Avail: NTIS HC A02/MF A01

Research into phase unwrapping has led to the discovery of a cellular automaton that can unwrap phase in one- and two-dimensions. The extremely interesting behavior of the automaton and the aesthetically pleasing structure that evolves from repeated iterates will be presented. DOE

N86-31290# Los Alamos National Lab., N. Mex.
AUTONOMOUS DIFFERENTIAL EQUATIONS FOR THE HENON MAP AND OTHER TWO-DIMENSIONAL DIFFEOMORPHISMS
G. Mayer-Kress 1986 19 p
(Contract W-7405-eng-36)
(DE86-007384; LA-UR-86-554) Avail: NTIS HC A02/MF A01

For the study of bifurcations and chaotic behavior of nonlinear dynamical systems discrete mappings turned out to be extremely useful. In order to study the smooth evolution underlying two dimensional invertible mappings, we discuss the suspension of the Henon map of the plane, the standard map on the torus and more general Cremona transformations of the plane. DOE

N86-31291# Oklahoma State Univ., Stillwater. Dept. of Physics.
SUPERCONFORMAL LAGRANGIAN WITHOUT THE NEED TO INTRODUCE CONSTRAINTS
C. H. Pilot Jan. 1986 40 p
(Contract DE-FG05-85ER-40215)
(DE86-009006; DOE/ER-40215/T2) Avail: NTIS HC A03/MF A01

A field Lagrangian invariant under all the symmetries of the superconformal group has been constructed without the need to introduce constraints on the curvatures. We have thus generalized the action of Townsend, van Nieuwenhuizen, and Kaku. We maintain that any and all constraints on the curvatures should result as a consequence of spontaneous symmetry breaking and not be a priori enforced. DOE

N86-31292# Sandia National Labs., Albuquerque, N. Mex.
PACKAGE FOR SOLVING LARGE SPARSE SYSTEMS OF STIFF ORDINARY DIFFERENTIAL EQUATIONS
D. E. Salane Feb. 1986 25 p
(Contract DE-AC04-76DP-00789)
(DE86-009545; SAND-85-2762) Avail: NTIS HC A02/MF A01

In this report we present a subroutine (DEBDFS) for solving large sparse systems of stiff ordinary differential equations. For many problems, DEBDFS is able to take advantage of sparsity to reduce significantly the cost of finding a solution. A preprocessor program acts as a user interface and makes DEBDFS reasonably easy to use. Moreover, the preprocessor program provides facilities for detailed problem analysis and helps the user to use DEBDFS efficiently. DOE

N86-31293# Sandia National Labs., Albuquerque, N. Mex.
EFFECTS OF STIFFNESS
L. F. Shampine Mar. 1986 18 p
(Contract DE-AC04-76DP-00789)
(DE86-009559; SAND-86-0304) Avail: NTIS HC A02/MF A01

One-step methods for the numerical solution of the initial value problem for a system of ordinary differential equations are studied. The question addressed is, what happens when a code intended for non-stiff problems is applied to a stiff problem. DOE

N86-31294# Oak Ridge National Lab., Tenn.
PROPAGATORS FOR GENERAL NONLINEAR EQUATIONS
D. G. Cacuci, R. B. Perez, and V. Protopopescu May 1986 14 p
(Contract DE-AC05-84OR-21400)
(DE86-010071; ORNL/TM-10016) Avail: NTIS HC A02/MF A01

Propagators - advanced and retarded - are introduced for nonlinear problems and it is shown that they generalize the Green's functions used to solve linear problems. These propagators are generated by using the dual operator which plays, for the nonlinear problem, the same role as the customary adjoint operator for linear problems. The propagators obey a reciprocity relationship and satisfy a closed nonlinear integral equation or, alternatively, a linear integral equation that depends parametrically on the

problem's solution. These equations are formulated in a canonical way, independent of dimensionally, boundary conditions and type of the underlying nonlinear problem. DOE

N86-31295# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
MARTINGALES WITH GIVEN ABSOLUTE VALUE FROM THE MULTIPLICATIVE DECOMPOSITION OF POSITIVE SUBMARTINGALES
D. Gilat and P. J. Holewijn Mar. 1984 13 p
(IR-224; ESA-86-97323) Avail: NTIS HC A02/MF A01

Methods of construction of martingales whose absolute value is preassigned are discussed. Two alternative constructions of a martingale whose absolute value is a given submartingale possessing a multiplication decomposition are presented. In the presence of a multiplicating decomposition the construction in continuous-time is no more difficult than for a submartingale-sequence. ESA

N86-31296# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
BINARY CONVEXITIES AND DISTRIBUTIVE LATTICES
M. vandeVel Mar. 1984 63 p
(IR-225; ESA-86-97324) Avail: NTIS HC A04/MF A01

The fact that the distributive lattices with convexity of all order-convex sublattices correspond exactly to the intervals of a binary convex structure which has a certain separation property is presented. These orderings are used for constructing an intrinsic topology of distributive lattices. Applications are given. ESA

N86-31297# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
AN INEQUALITY FOR STOPPED BROWNIAN MOTION
D. P. vanderVecht Mar. 1984 10 p
(IR-227; ESA-86-97326) Avail: NTIS HC A02/MF A01

The standard stopping time classes with respect to Brownian motion are considered. The fact that for any standard stopping time T, the distrubution of the maximum of stopping process associated to distribution Brownian Motion at T is dominated by Lebesgue measure of images of Hardy-Littelwood maximal function is proved. ESA

N86-31298# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
PROPERTY C AND FINE HOMOTOPY EQUIVALENCES
Jan vanMill and Jerzy Mogilski Mar. 1984 6 p
(IR-233; ESA-86-97327) Avail: NTIS HC A02/MF A01

The problem of dimensionality properties of infinite-dimensional spaces under fine homotopy equivalences is studied. The fact that the cell-like maps which are fine homotopy equivalences preserve countable dimension (property C) is proved. ESA

N86-31299# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
ON THE CONSTRUCTION OF MARTINGALES WITH GIVEN ABSOLUTE VALUE, 2
P. J. Holewijn Mar. 1984 17 p
(IR-241; ESA-86-97331) Avail: NTIS HC A02/MF A01

Methods of construction of martingales whose absolute value is preassigned are considered. It is shown how the problem of construction of martingales (with absolute value preassigned) can be reduced to the case where the given submartingale is bounded below by a constant nonrandom positive. ESA

N86-31300# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
ON GENERIC POINTS IN THE CARTESIAN SQUARE OF CHACON'S TRANSFORMATION
A. DelJunco and M. Keane Mar. 1984 19 p
(Grant NSF MCS-80-03038)
(IR-244; ESA-86-97334) Avail: NTIS HC A02/MF A01

The fact that there exists a compact space X and a strictly ergodic homeomorphism of X with invariant probability with the property that the set of couples of points which are not generic is a countable set, is proved. Chacon's transform is used. ESA

N86-31301# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
SOLUTIONS OF BOUNDARY VALUE PROBLEMS FOR THE TRICOMI-EQUATION
R. J. P. Groothuizen Mar. 1984 31 p
(IR-247; ESA-86-97337) Avail: NTIS HC A03/MF A01

The simple boundary value problem (elliptic and hyperbollic cases) for the homogeneous Tricomi equation is discussed. The fact that Fourier integral operators are more useful for describing qualitative than quantitative properties of solution is shown. The fact that the numerical aspect of the solution forms another problem is noted. ESA

N86-31302# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
THE ASYMPTOTIC EXPANSION OF THE GLOBAL ERROR OF THE BOX SCHEME IN A STIFF CASE
M. vanVeldhuizen Mar. 1984 28 p
(IR-251; ESA-86-97340) Avail: NTIS HC A03/MF A01

The existence of an asymptotic expansion of the global error for a stiff ordinary differential equation on a highly nonuniform mesh is considered. A stability estimate for the box scheme (scalar case only) almost without any restriction between the mesh and stiffness parameter is given. The possible extensions and the difficulties involved are also discussed. ESA

N86-31303# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
EXTRAPOLATED MIDPOINT RULE FOR DIFFERENTIAL EQUATIONS. PART 1: EXPANSION THEOREMS
Maarten deGee May 1984 39 p
(IR-255-Pt-1; ESA-86-97343) Avail: NTIS HC A03/MF A01

The approximation obtained by the explicit midpoint rule, initialized by one Euler step, of delay-differential equation is considered. The fact that there are functions ek such that the expansion of the global discretization error depending on ek exists even if the solution of delay-differential equation has jump discontinuities in its derivatives over certain points, is discussed. The fact the Richardson extrapolation to the limit is applied to improve the approximation is proved. Results show that the local extrapolation as in Gragg-Bulirsch-Stoer method for ordinary differential equations by consideration of a set of fixed step sizes can be used. ESA

N86-31304# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
DISCRETE APPROXIMATION OF EIGENFUNCTION EXPANSIONS OF SELF ADJOINT ORDINARY DIFFERENTIAL OPERATORS
G. Y. Nieuwland Jul. 1984 22 p Presented at Symposium dedicated to Professor A. van de Vooren, Groningen, Netherlands, 22 Jun. 1984
(IR-263; ESA-86-97347) Avail: NTIS HC A02/MF A01

The fact that the spectrum, spectral measures and the eigenfunctions for a self adjoint ordinary differential operator (ODO) can be approximated by numerically implementable algorithm is discussed. The fact that strong discrete approximation of a set adjoint ODO implies distributional convergence of spectral resolution is presented. ESA

N86-31305# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
THE BEST BOUND IN THE L LOG L INEQUALITY OF HARDY AND LITTLEWOOD AND ITS MARTINGALE COUNTERPART
David Gilat Sep. 1984 15 p Sponsored by Vrije Univ., Amsterdam, Netherlands
(IR-266; ESA-86-97348) Avail: NTIS HC A02/MF A01

The inequalities deduced from the maximal Hardy-Littlewood theorem and the Doob's theorem similar martingale are considered. The sharpness for the L log L (L times the logarithm of L) is studied. The best bound of L log L and its corresponding martingale description are presented. ESA

N86-31306# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
TRANSFINITE CLASSIFICATION OF WEAKLY-INFINITE DIMENSIONAL SPACES
Piet Borst Feb. 1985 35 p
(IR-276; ESA-86-97353) Avail: NTIS HC A03/MF A01

The fact that every weakly infinito-dimensional space X which does not have a weakly infinito-dimensional metric compactification can be an associate of two ordinal numbers called index X and weakly-ind X, is discussed. The fact that for every small infinito-dimensional space X the index is a function of the ordinal exponentiation, is proved. The number index X is a generalization of Pol's concept over weakly infinito-dimensional compact metric spaces. ESA

N86-31307# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
EXTREMAL DIGRAPHS WITHOUT DIRECTED PATHS OF LENGTH THREE OR TWO
A. Pawel Wojda May 1984 12 p
(Memo-449; ESA-86-97365) Avail: NTIS HC A02/MF A01

Diagraphs with $n > 3$ vertices and with exactly (nsq/4) arcs without a path of length 2 are described. Diagraphs with $n < 5$ vertices and (nsq/4) arcs without any directed path of length 3 are also described. ESA

N86-31308*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TESTING AND COMBINATION OF CONFIDENCE ELLIPSES: A GEOMETRIC ANALYSIS Final Report
Janet Myhre, Michael Rennie, and Will Duquette 5 Aug. 1985 54 p Prepared in cooperation with Mathematical Analysis Research Corp., Claremont, Calif.
(Contract NAS7-918)
(NASA-CR-176987; JPL-D-2782; NAS 1.26:176987; AD-A166581) Avail: NTIS HC A04/MF A01 CSCL 15/4

This document is one of a series of algorithm analysis reports performed for the US Army Intelligence Center and School covering selected algorithms in existing or planned Intelligence and Electronic Warfare (IEW) systems. This report proves several properties of the ellipse combination process as used in correlation algorithms, both alone and in combination with the associated statistical tests. In particular, it is shown that the statistical tests introduce order dependence to the combination process. A confidence ellipse, sometimes called an EEP, is one of the ways in which intelligence data concerning an emitter's location is summarized. Such an ellipse is always centered at the estimated emitter location and is a measure of the possible error in the location estimate. The goal of this paper is to examine the geometric implications and properties of the statistical test for deciding whether two estimates refer to the same emitter, and of the method of combination for confidence ellipses. GRA

N86-31420*# Prairie View Agricultural and Mechanical Coll., Tex. Dept. of Mechanical Engineering.
DEVELOPMENT OF A NUMERICAL PROCEDURE TO MAP A GENERAL 3-D BODY ONTO A NEAR-CIRCLE
Mark J. Hommel *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 5 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 12A

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N86-31309# Pittsburgh Univ., Pa. Center for Multivariate Analysis.
TABLES FOR OBTAINING CONFIDENCE BOUNDS FOR REALIZED SIGNAL TO NOISE RATIO WITH AN ESTIMATED DISCRIMINANT FUNCTION
C. G. Khatri, C. Radhakrishna Rao, and Y. N. Sun Nov. 1985 17 p
(Contracts N00014-85-K-0292; F49620-85-C-0008)
(AD-A166059; TR-85-40; AFOSR-86-0062TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Percentage points of a new distribution involving a confluent-hypergeometric distribution are tabulated. The use of the tabulated values in obtaining a lower confidence bound for the realized signal to noise ratio based on an estimated discriminant function for signal detection is explained. Author (GRA)

N86-31310# Stanford Univ., Calif. Dept. of Statistics.
ALL SUBSETS REGRESSION IN COX MODEL
Anthony Y. C. Kuk 4 Mar. 1986 16 p
(Contracts N00014-76-C-0475; NR Proj. 042-267)
(AD-A166897; TR-370) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper shows that within the framework of the proportional hazards model all subset regression can be performed with very little computational efforts. A selection criterion based on Wald statistic is motivated by a cross-validation argument in which the status of one observation is changed from uncensored to censored. This criterion is seen to be formally equivalent to Mallow's C sub P and thus the problem is reduced to one readily handled by standard statistical packages. The procedure is applied to the multiple myeloma data to give results remarkably different from those obtained by previous workers using stepwise procedures. New insights are gained and the superiority of all subset regression over stepwise regression is clearly demonstrated. GRA

N86-31311# Pittsburgh Univ., Pa. Center for Multivariate Analysis.
BOOTSTRAPPING NONLINEAR LEAST SQUARES ESTIMATES IN THE KALMAN FILTER MODEL
David S. Stoffer Jan. 1986 27 p
(Contract F49620-85-C-0008; Grant AF-AFOSR-0113-84)
(AD-A167099; TR-86-02; AFOSR-86-0252TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

The bootstrap is proposed as a method for estimating the precision of forecasts and maximum likelihood estimates of the transition parameters of the Kalman filter model when the estimates are obtained via Newton-Raphson. It is shown that when the system and the filter are in steady state, the bootstrap applied to the Gaussian innovations yields asymptotically consistant standard errors. That the boot strap works well with moderate sample sizes and supplies robustness against departures from normality is substantiated by emperical evidence. Author (GRA)

N86-31312# Oak Ridge National Lab., Tenn.
CENTRAL LIMIT THEOREM FOR VARIABLE SIZE SIMPLE RANDOM SAMPLING FROM A FINITE POPULATION
T. Wright Feb. 1986 27 p
(Contract DE-AC05-84OR-21400)
(DE86-007092; ORNL/TM-9864) Avail: NTIS HC A03/MF A01

This paper introduces a sampling plan for finite populations herein called variable size simple random sampling and compares properties of estimators based on it with results from the usual fixed size simple random sampling without replacement. Necessary and sufficient conditions (in the spirit of Hajek) for the limiting distribution of the sample total (or sample mean) to be normal are given. DOE

N86-31313# Oak Ridge National Lab., Tenn.
VARIANCE REDUCTION METHODS APPLIED TO DEEP-PENETRATION MONTE CARLO PROBLEMS
S. N. Cramer and J. S. Tang Jan. 1986 78 p
(Contract DE-AC05-84OR-21400)
(DE86-007080; ORNL/TM-9643) Avail: NTIS HC A05/MF A01

A review of standard variance reduction methods for deep-penetration Monte Carlo calculations is presented. Comparisons and contrasts are made with methods for nonpenetration and reactor core problems. Difficulties and limitations of the Monte

Carlo method for deep-penetration calculations are discussed in terms of transport theory, statistical uncertainty and computing technology. Each aspect of a Monte Carlo code calculation is detailed, including the natural and biased forms of (1) the source description, (2) the transport process, (3) the collision process, and (4) the estimation process. General aspects of cross-section data use and geometry specification are also discussed. Adjoint calculations are examined in the context of both complete calculations and approximate calculations for use as importance functions for forward calculations. The idea of importance and the realization of the importance function are coverd in both general and mathematical terms. Various methods of adjoint importance generation and its implementation are covered, including the simultaneous generation of both forward and adjoint fluxes in one calculation. A review of the current literature on mathematical aspects of variance reduction and statistical uncertainty is given. Three widely used Monte Carlo codes MCNP, MORSE, and TRIPOLI - are compared and contrasted in connection with many of the specific items discussed throughout the presentation. DOE

N86-31314# Technische Hogeschool, Eindhoven (Netherlands). Onderafdel. der Wiskunde en Informatica.
ASYMPTOTIC DISTRIBUTIONS IN PARAMETERIZED FUNCTIONAL RELATIONS [ASYMPTOTISCHE VERDELINGEN IN GEPARAMETRISEERDE FUNCTIONELE RELATIES]
H. N. Linssen and L. T. M. E. Hillegers Jul. 1984 27 p In DUTCH
(Memo-COSOR-84-09; ESA-86-97311) Avail: NTIS HC A03/MF A01

For a large class of functional relations the asymptotics of the estimators were derived using Wilks' theory of estimate equations. A special case of the theory, the normality of perceptual errors, was treated. The error covariance matrix was parameterized, which made the asymptotics complex, with an asymptotic dependance upon the structural parameter and error parameter estimators. Simple identification conditions are given. A calculus for the differentiation of multivariate statistical matrix functions was developed. ESA

N86-31315# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
SOME CONTINUITY THEOREMS IN PROBABILITY
D. P. vanderVecht May 1984 40 p
(IR-257; ESA-86-97345) Avail: NTIS HC A03/MF A01

A sequence of means of images of random variables of a continuous function is considered. The fact that a sequence of random variables is weakly convergent when the sequence of means of images of random variables depending on a continuous function is also convergent, is proved. The properties of functions of bounded variation are used. ESA

N86-31275# Technische Hogeschool, Eindhoven (Netherlands).
ON THE COHERENCE AMONG THE MULTITUDE OF SYSTEM IDENTIFICATION METHODS
P. Eykhoff and A. J. W. vandenBoom *In its* System Identification. Mini Course Jul. 1984 p 3-24 Presented at 6th IFAC Symposium on Identification and System Parameter Estimation, Washington, 1982 (For primary document see N86-31274 22-64)
Avail: NTIS HC A03/MF A01

N86-31276# Technische Hogeschool, Eindhoven (Netherlands).
A GENERALIZED DIAGRAM FOR VARIOUS PARAMETER ESTIMATION METHODS; THE COHERENCE IN PSEUDO-LINEAR REGRESSION SCHEMES
P. Eykhoff and A. J. W. vandenBoom *In its* System Identification. Mini Course Jul. 1984 p 25-37 (For primary document see N86-31274 22-64)
Avail: NTIS HC A03/MF A01

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N86-31316*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TOWARDS AUTOMATIC MARKOV RELIABILITY MODELING OF COMPUTER ARCHITECTURES
Carlos A. Liceaga and Daniel P. Siewiorek (Carnegie-Mellon Univ., Pittsburgh, Pa.) Aug. 1986 67 p
(NASA-TM-89009; NAS 1.15:89009) Avail: NTIS HC A04/MF A01 CSCL 12B

The analysis and evaluation of reliability measures using time-varying Markov models is required for Processor-Memory-Switch (PMS) structures that have competing processes such as standby redundancy and repair, or renewal processes such as transient or intermittent faults. The task of generating these models is tedious and prone to human error due to the large number of states and transitions involved in any reasonable system. Therefore model formulation is a major analysis bottleneck, and model verification is a major validation problem. The general unfamiliarity of computer architects with Markov modeling techniques further increases the necessity of automating the model formulation. This paper presents an overview of the Automated Reliability Modeling (ARM) program, under development at NASA Langley Research Center. ARM will accept as input a description of the PMS interconnection graph, the behavior of the PMS components, the fault-tolerant strategies, and the operational requirements. The output of ARM will be the reliability of availability Markov model formulated for direct use by evaluation programs. The advantages of such an approach are (a) utility to a large class of users, not necessarily expert in reliability analysis, and (b) a lower probability of human error in the computation. Author

N86-31317# Alphatech, Inc., Burlington, Mass.
STUDIES IN MATHEMATICAL MODELS OF HUMAN DECISION-MAKING IN GAMING SITUATIONS Final Report, 1 Aug. 1984 - 31 Jan. 1986
David A. Castanon 6 Apr. 1986 155 p
(Contract N00014-84-C-0458)
(AD-A166698; TR-283) Avail: NTIS HC A08/MF A01 CSCL 05/10

This document studies two classes of mathematical models of dynamics multiperson decisionmaking which focus on the subjective nature of human decisionmaking. It develops extensions to game theory models which allow for differences in subjective perceptions of the decision problem among decisionmakers. Studies are the effects of these extensions on qualitative results available for two multiperson decisionmaking paradigms, one cooperative and one noncooperative, and characterize new classes of outcomes which become rational under our theory. The results provide a foundation for the development of a quantitative predictive theory of multiperson decisionmaking which incorporates the subjective properties of human decisionmaking behavior. GRA

N86-31318# Oak Ridge National Lab., Tenn.
DETERMINISTIC SENSITIVITY THEORY FOR NONLINEAR SYSTEMS: THE FORWARD AND THE ADJOINT METHOD
D. G. Cacuci 1986 80 p Presented at the ISPRA Course on Data Uncertainties, Sensitivities, Consistency and Adjustment, Ispra, Italy, 14 Apr. 1986
(Contract DE-AC05-84OR-21400)
(DE86-009512; CONF-8604168-1) Avail: NTIS HC A05/MF A01

The main aspects underlying the rigorous mathematical formulation of deterministic sensitivity theory for nonlinear systems are presented; this formulation is based on the work by Cacuci and employs concepts and methods of nonlinear functional analysis. The functional analytic concepts underlying sensitivity theory are briefly reviewed in Section 2. The rigorous formulation of sensitivity theory for nonlinear systems is presented in Section 3. Section 3. A presents the sensitivity theory for nonlinear

systems with operator-type responses. Section III.B presents the development of the sensitivity theory for nonlinear systems with responses defined at critical points of a function of the system's state vector and parameters (maxima, minima, and saddle points). Section III.C presents sensitivity theory for nonlinear systems with feedback. Finally, Section IV summarizes and highlights the main points underlying deterministic sensitivity theory for nonlinear systems and discusses the potential of using functional analytic concepts to extend further the scope of this theory. DOE

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N86-31319# Wisconsin Univ., Milwaukee. Dept. of Mathematical Sciences.
SIEVES FOR GAUSSIAN PROCESSES Annual Report, 30 Sep. 1984 - 29 Sep. 1985
Jay H. Beder 27 Nov. 1985 6 p
(Grant AF-AFOSR-0329-84)
(AD-A166055; AFOSR-86-0069TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Several important properties of a proposed sieve estimator for the mean of a Gaussian process of known covariance have been established. The estimator is itself a Gaussian process; under a separability assumption, it is asymptotically unbiased and weakly consistent at each time t, and is strongly consistent (globally) in an appropriate norm. For a Gaussian process with zero mean and unknown covariance, it is shown that the likelihood for the covariance is in general unbounded almost surely. Moreover, properties of a proposed sieve estimator have been developed for the covariance analogous to those for the mean. No assumption is made about the nature of the time parameter t, either for the mean estimator or for the covariance estimator.
Author (GRA)

N86-31320# University of Northern Illinois, De Kalb.
SEQUENTIAL AND PARALLEL MATRIX COMPUTATIONS Interim Report, 1 Sep. 1984 - 31 Aug. 1985
Biswa N. Datta Nov. 1985 6 p
(Grant AF-AFOSR-0334-83)
(AD-A166062; AFOSR-86-0067TR) Avail: NTIS HC A02/MF A01 CSCL 09/2

The major objectives of this project are to develop computational algorithms, both sequential and parallel, for several important linear algebra problems that arise in the design and analysis of linear control systems governed by the systems of ordinary differential equations. These include controllability problems, stability and inertia problems, pole assignment problems, matrix equations problems, relative primeness of polynomials and matrices and the cauchy-index problems of rational functions etc. Besides, a part of the project is devoted to the theoretical study of the parallel arithmetic complexity of these problems; that is, how fast these problems can be solved in parallel assuming that sufficiently many processors are available. Though some numerically viable sequential algorithms have been designed for some of these problems in recent years, parallel algorithms and algorithms for large scale problems are virtually non-existent. GRA

N86-31321# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
VARIATIONAL COUPLING BETWEEN Q-NUMBER AND C-NUMBER DYNAMICS [ACOPLAMENTO VARIACIONAL ENTRE DINAMICAS Q-NUMBER E DINAMICAS C-NUMBER]
C. M. do Amaral and S. Joffily 1984 18 p In PORTUGUESE
(DE86-700604; CBPF-NF-066/84) Avail: NTIS (US Sales Only) HC A02/MF A01

The time-dependent quantum variational principle is generalized for the case of Hamiltonian operators having real parameters and their time derivates. The obtained variational system is formed by a Schroedinger equation coupled to a Lagrange equation system. Where the lagrangian is the average value of the parametrized Hamiltonian operator. The consequent dynamics of the variational principle describes the interaction between a q-number sub-dynamics with a c-number sub-dynamics. In the (h/2(PI))(0)-order W.K.B. approximation, the variational system reduces to a Hamilton-Jacobi-like equation, coupled to a lagrange equation family. The formal features of the obtained variational system are appropriated for the description of, adiabatics and non-adiabatics, time-dependent q-number c-number interactions. DOE

N86-31322# Osaka City Univ. (Japan). Dept. of Physics.
FIELD THEORY OF STRINGS. EFFECTIVE ACTION FOR MASSLESS FIELDS
Keiji Kikkawa May 1985 13 p Presented at the International Symposium on Quantum Field Theory, Positano, Italy, May 1985
(DE86-900006; OU-HET-76) Avail: (US Sales Only) NTIS HC A02/MF A01

After giving a review for the field theory of string and the recent development in the superstring theory, the effective action for massless particles in the string theory is introduced. In the zero-slope limit the action is shown to reduce to the Einstein gravity theory with vanishing cosmological constant plus a massive dilaton term. DOE

N86-31323# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
THE HASSE-WITT MATRIX OF A FORMAL GROUP
H. A. W. M. Kneppers May 1984 24 p
(IR-238; ESA-86-97329) Avail: NTIS HC A02/MF A01

A lifting of the Hasse-Witt matrix (matrix of the semilinear Frodenius map) containing the structure constants of a formed group is considered. The fact that the classification up to isomorphism of smooth commutative formal groups is a matter of finding normal forms for Hasse-Witt matrix of formal groups is used. Preliminary reductions of formal groups of an algebraic curve of arbitrary dimension over an algebraically closed field are derived. The intrinsic definitions of the discrete isomorphism invariants are given. The fact that the covariant classification of two-dimensional smooth commutative formed groups using discrete isomorphism invariants is more transparent and needs less subcases than other techniques is proved. ESA

N86-31324# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
A METHOD FOR CONSTRUCTING ORDERED CONTINUA
Klaas Pieter Hart and Jan vanMill Mar. 1984 25 p
(IR-240; ESA-86-97330) Avail: NTIS HC A02/MF A01

Compact, connected linear ordered topological spaces (ordered continuums) are considered. A general method for constructing ordered continua from families of subjets of the real interval of extremities 0 and 1 is given. An example of a continuum with the property that every uncountable subset contains an uncountable subset isomorphic to the subset of the real numbers system is given. ESA

N86-31325# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
THE HOPF ALGEBRA OF SYMMETRIC FUNCTIONS [DE HOPFALGEBRA VAN DE SYMMETRISCHE FUNCTIES]
E. J. Ditters May 1984 98 p In DUTCH
(IR-250; ISBN-90-71058-01-8; ESA-86-97339) Avail: NTIS HC A05/MF A01

The isomorphism theta between the Hopf algebra of symmetric funtions in the complex plane (C) and theta R(Sn) for n=0... infinite (R(Sn) is the ring of virtual complex representations of the symmetric group Sn) was studied to find the in-product on the last ring in C. Using Liulevicus, proofs applicable to other basic rings than just in the real plane are derived. Two canonical bilinear forms in C, one positively definite corresponding with the classical in-product, and the other indefinite, were constructed. Without using representations, the existence of an orthonormal base (Schur-functions) is found. Using Dieudonne, S-adic symmetric functions are defined. An S-adic Newton rule and a duality proposition for

the S-adic symmetric functions algebra are found. A representation of Grothendiecks lambda-ring is given, using Hilbert operators from the theory of commutative formal groups, valuable for rings without additive torsion, and satisfying mild mathematical conditions. ESA

N86-31326# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
A SEPARABLE NORMAL TOPOLOGICAL GROUP WHICH IS NOT LINDELOEF
Klaas Pieter Hart and J. vanMill May 1984 17 p
(IR-252; ESA-86-97341) Avail: NTIS HC A02/MF A01

An example of a separable normal group which contains a closed subspace homeomorphic to an incountable regular cardinal, in Zermelo-Frankel Choice axiom (ZFC) is given. This is a negative answer to the question when a separable normal topological space is not Lindelof. A separable hereditary normal topological group without nice covering properties in ZFC is not shown. ESA

N86-31327# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
CONVEX HILBERT CUBES IN SUPEREXTENSIONS
M. vandeVel Mar. 1984 18 p
(IR-254; ESA-86-97342) Avail: NTIS HC A02/MF A01

It is proved that every nondegenerate compact convex subset of the superextension (all maximal linked families of closed subsets of a normal space Z) of a metric continuum is homeomorphic to the Hilbert cube. The selection theorem for convex structures is used. Two related open problems are described. ESA

N86-31328# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
FUNCTION SPACES OF LOW BOREL COMPLEXITY
J. Dijkstra, T. Grilliot, D. Lutzer, and J. vanMill Jun. 1984 17 p
(IR-260; ESA-86-97346) Avail: NTIS HC A02/MF A01

The set C(x) of continuous real valued functions on a topological space X with the product topology on R sup X is considered. The fact that C(X) is dense in R sup X is proved. The fact that C(X) is dense in R sup x is equivalent to C(X) is completely Harsdurff, is also proved. ESA

N86-31329# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
INVARIANT ARCS, WHITNEY LEVELS, AND KELLEY CONTINUA
M. vandeVel Oct. 1984 41 p
(IR-268; ESA-86-97349) Avail: NTIS HC A03/MF A01

The convexity in spaces of arcs is considered. An arc is mapped back onto itself in spaces of arcs. It is shown that certain Whitney levels are absolute retracts. The Kelley continua is characterized by approximating coselections. ESA

N86-31330# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
A DOWKES GROUP
Klaas Pieter Hart and Jan vanMill Nov. 1984 13 p
(IR-269; ESA-86-97350) Avail: NTIS HC A02/MF A01

An example of a normal topological group whose product with the circle group is not normal is given. The group is constructed in Zermelo-Fraenkel choice only. ESA

N86-31331# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
THE AZEMA-YOR STOPPING TIME AND ULTIMATENESS
D. P. vanderVecht Jan. 1985 7 p
(IR-273; ESA-86-97351) Avail: NTIS HC A02/MF A01

The sequences of standard Brownian motion with stopping time standard are considered. A uniqueness-property for the stopping time of Azema-Yor's (1977) models (special standard stopping time T with respect to the class of Brownian motion standard stopping Times) is proved. ESA

N86-31332# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
ON THE PRODUCT OF HOMOGENEOUS SPACES
W. W. Comfort and Jan vanMill Jan. 1985 24 p
(IR-274; ESA-86-97352) Avail: NTIS HC A02/MF A01

The productive closure in the indetermediate class of homogeneous spaces is considered. The fact that in Zermelo-Fraenkel Choice there are pseudocompact, homogeneous spaces such that the product is not pseudocompact is proved. When the Martin Axiom is supposed the component spaces may be chosen countably compact. The results are a consequence of Uspenski's Theorem. The fact that every compact space can be embedded as a retract in a countably compact homogeneous space is also proved. The fact that for every cardinal number there exists a countably compact, homogeneous space whose Souslin numbers exceeds this cardinal number, is reported. ESA

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

N86-31333# Lawrence Livermore National Lab., Calif.
ENERGY AND TECHNOLOGY REVIEW, JUNE 1985
Gordon L. Struble, ed., Wallace E. Clements, ed., Lauren deVore, ed., Mary Ann Esser, ed., Eleanor M. ONeal, ed., and Palmer T. VanDyke, ed. Jun. 1985 43 p
(Contract W-7405-eng-48)
(DE85-014146; UCRL-52000-85-6) Avail: NTIS HC A03/MF A01

Topics covered in this issue include: short-wavelength laser, fractional quantum Hall effect, and quantum-mechanical simulation of liquids. Abstracts of individual items were prepared separately for the data base. DOE

N86-31334# JAYCOR, San Diego, Calif.
PRODUCTION OF ULTRAHIGH MAGNETIC FIELDS Technical Progress Report
25 Oct. 1985 75 p
(Contract DE-FG03-84ER-13302)
(DE86-006838; DOE/ER-13302/T1) Avail: NTIS HC A04/MF A01

A general method for producing controlled ultrahigh magnetic fields up to the order to 100 MG has been proposed recently. The general method involves imploding a plasma in which a magnetic field has been entrained. The imploding plasma compresses the magnetic field to high strengths. This paper reports the experimental test at the 1 to 2 MG level and high repetition rate of an embodiment of this method using a gas-puff Z pinch. DOE

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environment Pollution*.

N86-31335*# Purdue Univ., West Lafayette, Ind. School of Mechanical Engineering.
A STUDY OF METHODS TO PREDICT AND MEASURE THE TRANSMISSION OF SOUND THROUGH THE WALLS OF LIGHT AIRCRAFT Semiannual Status Report, 1 Oct. 1985 - 15 May 1986
R. J. Bernhard, J. S. Bolton, B. Gardner, J. Mickol, C. Mollo, and C. Bruer May 1986 35 p
(Grant NAG1-58)
(NASA-CR-177147; NAS 1.26:177147; PRF-520-1288-0353; Rept-0353-3; HL86-19) Avail: NTIS HC A03/MF A01 CSCL 20A

Progress was made in the following areas: development of a numerical/empirical noise source identification procedure using bondary element techniques; identification of structure-borne noise paths using structural intensity and finite element methods;

development of a design optimization numerical procedure to be used to study active noise control in three-dimensional geometries; measurement of dynamic properties of acoustical foams and incorporation of these properties in models governing three-dimensional wave propagation in foams; and structure-borne sound path identification by use of the Wigner distribution. Author

N86-31336*# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
VIBRATION AND STRUCTUREBORNE NOISE IN SPACE STATION Progress Report, 1 Jan. - 30 Jun. 1986
Rimas Vaicaitis 1986 23 p
(Grant NAG1-541)
(NASA-CR-177146; NAS 1.26:177146) Avail: NTIS HC A02/MF A01 CSCL 20A

Analytical models and computer programs for structural response calculations under action of mechanical point loads were developed for single wall shells (composite or aluminum), double wall shells (composite or aluminum), and single wall or double wall circular plates (aluminum). The design configuration of the habitability modules of the space station concept are expected to be discretely stiffened cylindrical shells with truncated cone type end caps or flat but stiffened circular end plates. Analytical formulations and response calculations were performed for the case where the stiffened shell is represented by an orthotropic shell model. The natural frequencies can be calculated. For application to low frequency (below 1000Hz) vibrations and noise generation, such a model might be adequate to evaluate vibration and noise transmission characteristics of space station habitability modules. Parametric studies are now being performed to assess interior noise environment inside a habitability module to mechanically induced vibrations. B.G.

N86-31337*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ACOUSTIC TREATMENT OF THE NASA LANGLEY 4- BY 7-METER TUNNEL: A FEASIBILITY STUDY
James C. Yu and A. Louis Abrahamson (Comtek, Grafton, Va.) Aug. 1986 38 p
(NASA-TP-2563; L-16037; NAS 1.60:2563) Avail: NTIS HC A03/MF A01 CSCL 20A

A feasibility study for upgrading the NASA Langley 4- by 7-Meter Tunnel so that it may be used for aeroacoustic research related to helicopters is described. The requirements for noise research leading to the design of the next generation of helicopters impose a set of acoustic test criteria that no existing wind tunnel in the United States can presently meet. Included in this feasibility study are the following considerations: (1) an evaluation of general wind-tunnel requirements and desired tunnel background noise levels for helicopter aeroacoustic research; (2) an assessment of the present acoustic environment for testing model rotors; (3) a diagnostic investigation of tunnel background noise sources and paths; (4) acoustic treatment options for tunnel background noise reduction and a trade-off study between these options; (5) an engineering feasibility assessment of the selected option; and (6) an integrated analysis of study components and recommendations of treatment for an approach to meet the tunnel background noise reduction goal. It is concluded that the Langley 4- by 7-Meter Tunnel is a fundamentally suitable facility for helicopter aeroacoustic research. It is also concluded that acoustic treatment of this facility for meeting the required tunnel background noise goal can be accomplished technically at reasonable risk and cost. M.G.

N86-31338*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ADVANCED TURBOPROP NOISE PREDICTION: DEVELOPMENT OF A CODE AT NASA LANGLEY BASED ON RECENT THEORETICAL RESULTS
F. Farassat, M. H. Dunn (PRC Kentron, Inc., Hampton, Va.), and S. L. Padula Jul. 1986 58 p Presented at the 9th AIAA Aeroacoustics Conference, Williamsburg, Va., Oct. 1984
(NASA-TM-88993; NAS 1.15:88993; AIAA-84-2303) Avail: NTIS HC A04/MF A01 CSCL 20A

The development of a high speed propeller noise prediction code at Langley Research Center is described. The code utilizes two recent acoustic formulations in the time domain for subsonic and supersonic sources. The structure and capabilities of the code are discussed. Grid size study for accuracy and speed of execution on a computer is also presented. The code is tested against an earlier Langley code. Considerable increase in accuracy and speed of execution are observed. Some examples of noise prediction of a high speed propeller for which acoustic test data are available are given. A brisk derivation of formulations used is given in an appendix. Author

N86-31339*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STRUCTUREBORNE NOISE IN AIRCRAFT: MODAL TESTS
Sherman A. Clevenson and Vern L. Metcalf Jul. 1986 36 p
(DA Proj. 1L1-61102-AH-45)
(NASA-TM-87739; NAS 1.15:87739; USAAVSCOM-TM-86-B-3) Avail: NTIS HC A03/MF A01 CSCL 20A

As part of an investigation to develop measurement techniques for structureborne noise, three modal surveys have been conducted on an OV-10A aircraft and the results have been presented. The purpose of the modal surveys was to identify suitable locations for mounting accelerometer and strain gages in subsequent tests in which transfer functions relating wing vibration to interior noise were to be determined. These surveys are as follows:(1) wing/fuselage modal survey utilizing one shaker under the right wing; (2) complete wing modal survey utilizing two shakers, one under each wing; and (3) fuselage side panel modal survey utilizing a small instrumented hammer. The predominant frequencies and damping ratios for each analysis were listed in tables. The primary mode shapes at the lower frequencies and at frequencies near the expected engine driving frequencies have been shown for each survey. Author

N86-31340*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ACOUSTICS DIVISION RECENT ACCOMPLISHMENTS AND RESEARCH PLANS
Lorenzo R. Clark and Homer G. Morgan Jul. 1986 144 p
(NASA-TM-89012; NAS 1.15:89012) Avail: NTIS HC A07/MF A01 CSCL 20A

The research program currently being implemented by the Acoustics Division of NASA Langley Research Center is described. The scope, focus, and thrusts of the research are discussed and illustrated for each technical area by examples of recent technical accomplishments. Included is a list of publications for the last two calendar years. The organization, staff, and facilities are also briefly described. Author

N86-31341*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DIRECTIVITY AND TRENDS OF NOISE GENERATED BY A PROPELLER IN A WAKE
P. J. W. Block and Carl L. Gentry, Jr. Sep. 1986 63 p
(NASA-TP-2609; L-16131; NAS 1.60:2609) Avail: NTIS HC A04/MF A01 CSCL 20A

An experimental study of the effects on far-field propeller noise of a pylon wake interaction was conducted with a scale model of a single-rotation propeller in a low-speed anechoic wind tunnel. A detailed mapping of the noise directivity was obtained at 10 test conditions covering a wide range of propeller power landings at several subsonic tip speeds. Two types of noise penalties were investigated-pulser and spacing. The pusher noise penalty is the difference in the average overall sound pressure level, OASPL, for pusher and tractor installations. (In a pusher installation, the propeller disk is downstream of a pylon or another aerodynamic surface.) The spacing noise penalty is the difference in the average OASPL for different distances between the pylon trailing edge and the propeller. The variations of these noise penalties with axial, or flyover, angle theta and circumferential angle phi are presented, and the trends in these noise penalties with tip Mach number and power loading are given for selected values of theta

and phi. The circumferential directivity of the noise from a pusher installation showed that the addition noise due to the interaction of the pylon wake with the propeller had a broad peak over a wide range of circumferential angles approximately perpendicular to the pylon with a sharp minimum 90 deg. to the pylon for the majority of cases tested. The variation of the pusher noise penalty with theta had a minimum occurring near the propeller plane and maximum values of as much as 20 dB occurring toward the propeller axes. The magnitude of the pusher noise penalty generally decreased as propeller tip Mach number or power loading was increased. Author

N86-31342# Systems Control Technology, Inc., Palo Alto, Calif.
TRACK PARAMETER EXTRACTION USING MULTIPATH DELAY AND DOPPLER INFORMATION Final Report
Khosrow Lashkari, Benjamin Friedlander, and Jonathan Abel Feb. 1986 195 p
(Contract N00014-84-C-0408)
(AD-A166044; Rept-5517) Avail: NTIS HC A09/MF A01 CSCL 17/1

The goal of the multipath project is to develop techniques to make use of the multipath reflections of acoustic signals travelling in the ocean to localize and track radiating sources. There have been two main areas of study under this contract. The first area concentrates on the detection and estimation of the multipath (or differential) delays in the received signals; the second is the development of localization and tracking algorithms. Previous work on the multipath project included the development of differential delay estimation algorithms as well as theoretical studies resulting in bounds on the variance of estimating multipath delay. Bounds were also placed on the accuracy of estimating various so-called track parameters -speed, depth, and range at closest approach of the target to the sensor array. Under the present contract, software was developed to estimate multipath delay using real or simulated data as input. Also under the present contract, tracking algorithms were developed. GRA

N86-31343# Texas Univ., Austin. Dept. of Mechanical Engineering.
PROBLEMS IN NONLINEAR ACOUSTICS: PARAMETRIC RECEIVING ARRAYS, FOCUSED FINITE AMPLITUDE SOUND AND DISPERSIVE NONLINEAR INTERACTIONS Annual Summary Report, 1 Sep. 1985 - 30 Apr. 1986
Mark F. Hamilton 30 Apr. 1986 23 p
(Contract N00014-85-K-0708)
(AD-A167311; ASR-1) Avail: NTIS HC A02/MF A01 CSCL 20/1

Contract N00014-85-K-0708 provides for basic research on nonlinear acoustics. The three projects currently supported by the contract are as follows: 1) Use of a Parametric Receiving Array to Measure Ship Noise; 2) Focused Finite Amplitude Sound; and 3) Dispersive Nonlinear Wave Interactions in a Duct. The first project is the primary research effort supported by the contract, and the investigation is predominantly theoretical. The second involves computational analysis, the third experimental. Each project is discussed separately in the following sections. GRA

N86-31344# Department of the Air Force, Washington, D.C.
DUCTLESS ACOUSTICAL NOISE ATTENUATOR Patent Application
Robert H. Eustace, inventor (to Air Force) Filed 12 Mar. 1986 14 p
(AD-D012288; US-Patent-Appl-SN-838850) Avail: NTIS HC A02/MF A01 CSCL 13/1

A ductless noise attenuator is disclosed which includes a supply fitting mounted between an air conditioning unit and a recipient. The supply fitting blocks line-of-sight soundwaves using triangular-shaped protrusions on the inlet and outlet edges of a housing, and diamond-shaped core which fits in the housing and has edges which extend to the space between the triangular-shaped edges of the inlet and outlet of the housing. The diamond-shaped core is composed of: two leading edges, which form a wedge with its point facing the housing inlet; and two trailing edges which is overlapped by the triangular protrusions of the housing. Finally, a return fitting conducts air back to the air conditioning unit while blocking line-of-sight soundwaves with a diagonal divider within a return housing. The design of the attenuator is intended to provide a mininum construction on the airflow from the air conditioning unit, with a maximum of sound attenuation at audible frequencies by blocking line-of-sight soundwaves. GRA

N86-31345# Department of Energy, Morgantown, W. Va.
SURFACE ACOUSTIC WAVE DUST-DEPOSITION SENSOR
G. E. Fasching and N. S. Smith Feb. 1986 16 p
(DE86-001068; DOE/METC-86-4059) Avail: NTIS HC A02/MF A01

Surface acoustic waves travel by interaction between the atoms near the surface of a solid, with the consequence that attenuation of these waves can be sensitive to dust accumulation on the surface across which they propagate. This report reviews the relevant acoustic theory and its application to the design of a system for evaluating the feasibility of using the attenuation of surface acoustic waves for monitoring surface dust-deposition rates. The monitoring system is described, and the results of preliminary experiments are given. The results indicate that multireflected surface acoustic waves are attenuated sufficiently by a specified, maximum dust-layer surface density of 3.10 x 10(5) mg/m(2) (200 mg/in(2)) and that this approach should be investigated further for application in high-temperature, corrosive-atmosphere, coal-conversion process applications. DOE

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N86-31346# Arizona Univ., Tucson. Dept. of Physics.
TIME-OF-FLIGHT SPECTROSCOPY OF IONIC AND METASTABLE FRAGMENTS FROM DISSOCIATING MOLECULES Final Technical Report, 15 Jun. 1980 - 14 Jun. 1985
Willis E. Lamb, Jr. and L. C. McIntyre, Jr. 14 Oct. 1985 40 p
(Grant AF-AFOSR-0218-80)
(AD-A166063; AFOSR-86-0071TR) Avail: NTIS HC A03/MF A01 CSCL 07/4

This research involved the dissociation of hydrogen-containing molecules by electron impact and the subsequent measurement of the velocity of proton or metastable hydrogen fragments using time-of-flight methods. The proton velocity distribution resulting from dissociation of the hydrogen halides resulted in information on excited states of the corresponding molecular ions with inner-shell electron holes. Another completed project involved the proton velocity distribution from electron bombardment of the triatomic molecules, water and hydrogen sulfide. A final experiment involved the detection, in coincidence, of proton and metastable hydrogen fragments from electron bombardment of hydrogen molecules. GRA

N86-31347# Hawaii Univ., Honolulu. Dept. of Physics and Astronomy.
DEVELOPMENT OF LOW-ENERGY X-RAY SPECTROGRAPH SYSTEM Final Technical Report, 1 Jun. 1983 - 31 May 1984
Burton L. Henke Dec. 1985 10 p
(Grant AF-AFOSR-0222-83)
(AD-A166195; AFOSR-86-0052TR) Avail: NTIS HC A02/MF A01 CSCL 20/8

The technical report describes the design and construction of a state of the art, large aperture focussing spectrograph of the Johann/Johannson geometry, specially developed for the low energy x ray region of 50-5000 eV. The spectrographic system includes (1) a four kilowatt, demountable low voltage x ray excitation source, (2) a three-position holder for samples which are closely coupled to the excitation source and with a variable take-off angle, (3) a stepping motor driven scanner which accomodates large aperture curved crystal analyzers, a 10 in. diameter focussing circle, and an automatically adjusted exit slit that provides a constant solid angle of measured radiation from the same sample area

and at the same time take off angle for all Bragg angles, (4) tunable gas flow, sub-atmospheric pressure counter, and finally (5) provisions for a rapid and easy interchange of thin window filter mounts for both the x ray source and for the counter. A small computer has been specially interfaced to provide scan control, data acquisition and presentation, and preliminary data analysis. It is connected to a large computer for programmed resolution enhancement, de-convolution and the determination of absolute radiative yields from the experimental, overlapping atomic or molecular orbital spectral components. GRA

N86-31348# SRI International Corp., Menlo Park, Calif. Physical Sciences Div.
STUDIES OF HIGHLY EXCITED ATOMS Final Report
Ravinder Kachru 2 Apr. 1986 72 p
(Contract N00014-79-C-0202)
(AD-A166838; AD-E950814) Avail: NTIS HC A04/MF A01 CSCL 17/5

Rydberg states of atoms have intrinsic properties that should allow their use as highly sensitive and tunable detectors at far infrared wavelengths. The intrinsic limit of such atomic detectors are collisional processes. This report describes the results of a research program to better understand an important class of collisions--namely, the resonant collision of two Rydberg atoms. We have extensively measured the linewidths and the collision cross sections and have determined their dependence on parameters such as the principal quantum number and the Rydberg state angular momentum. The resonant collisions are shown to occur for a wide variety of initial states with cross sections of the order of 10 to the 9th power square-Angstroms and scaling as (n*O to the 4th order). GRA

N86-31349# Los Alamos National Lab., N. Mex.
EXPERIMENT TO MEASURE THE GRAVITATIONAL FORCE ON THE ANTIPROTON
Ronald E. Brown 1985 16 p Presented at the Workshop on the Design of A Low Energy Antimatter Facility, Madison, Wis., 3-5 Oct. 1985
(Contract W-7405-eng-36)
(DE86-008725; LA-UR-86-820; CONF-8510263-2) Avail: NTIS HC A02/MF A01

A collaboration has been formed to measure the acceleration of antiprotons in the earth's gravitational field. The technique is to produce, decelerate, and trap quantities of antiprotons, to cool them to untralow energy, and to measure their acceleration in a time-of-flight experiment. Present plans and the results of initial efforts toward this end are presented. DOE

N86-31350# Max-Planck-Inst. fuer Physik und Astrophysik, Münich (West Germany). Werner-Heisenberg-Inst. fuer Physik.
[ACTIVITIES OF THE WERNER-HEISENBERG INSTITUTE OF PHYSICS] Annual Report, 1985
Jan. 1986 173 p In GERMAN
(ISSN-0173-6256; ESA-86-97430) Avail: NTIS HC A08/MF A01

The Experimental Division A performed experiments at CERN, on the Teratron accelerator of the Fermilab and on the electron-positron storage ring PETRA using the CELLO-detector; experiments on the electron-proton storage ring HERA and preliminary investigations of a possible double-beta-decay experiment were conducted; electronic devices, and data processing and evaluation systems were developed. The Experimental Division B made investigations of charm particles in hadronic interaction, and phenomenological studies; the ALEPH project is prepared for the electron-position storage ring LEP; silicon detectors, integrated electronics, and calorimeters were developed. The organization of the technical division and its tasks for current and planned experiments are described. The research work of the theoretical division (renormalization, grid calibration, elementary particles, standard model, cosmology, neutrino detector, quantum mechanics, nonlinear multiparticle physics) is summarized. ESA

N86-31351# Stockholm Univ. (Sweden). Inst. of Physics.
INDUCED HIGGS COUPLINGS TO NEUTRAL BOSONS IN E+E- COLLISIONS
L. Bergstroem and G. Hulth Feb. 1985 30 p Sponsored by Swedish Natural Science Research Council
(USIP-85-08; ESA-86-97228) Avail: NTIS HC A03/MF A01

Induced couplings of the type HVgamma in the standard model, where H is a Higgs meson and V is a virtual or real neutral gauge boson are calculated. Applications for e+e- collisions and Higgs meson decays are given. The calculated rates are too low to make these processes an attractive way to search for the Higgs boson. However, once it is found, it is argued that these processes should be studied experimentally since the induced couplings probe the structure of the gauge theory in an interesting way. It may be possible to infer the existence of one or more heavy fermion generations by observing their virtual effects in radiative decays into Higgs particles. The related coupling HVgamma with V a heavy quarkonium vector state is mentioned. ESA

N86-31352# Stockholm Univ. (Sweden). Inst. of Physics.
IDENTIFICATION OF NEUTRAL HIGGS BOSONS IN THE DELPHI DETECTOR AT LEP
P. O. Hulth and K. Hultquist Mar. 1985 26 p
(USIP-85-09; ESA-86-97229) Avail: NTIS HC A03/MF A01

A Monte Carlo study was performed to investigate the possibilites of observing and identifying a neutral Higgs boson H(0) in the DELPHI detector using the reaction e+e- yields Z(0) yields l(+) l(-) where l(+) and l(-) are leptons. Methods for identifying the H by its decay characteristics as predicted by the Lund Monte Carlo were considered. The most promising methods for identifying the H through its decay are the sphericity of the decay products in the H rest system and the number of leptons in the H decay. These methods require an integrated luminosity in the region 20 to 300 p/b, depending on the H mass, for a 3 sigma separation between H decay and the decay of a particle with equal couplings to all quarks. ESA

N86-31353# Stockholm Univ. (Sweden). Inst. of Physics.
FEYNMAN DIAGRAMS AS FUNCTIONS OF QUARK MASS MATRICES, CP-VIOLATION, ELECTRIC DIPOLE MOMENTS AND THETA-PARAMETER OF QCD
C. Jarlskog Nov. 1985 17 p Sponsored by Swedish Natural Science Research Council
(USIP-85-22; ESA-86-97230) Avail: NTIS HC A02/MF A01

Feynman diagrams of the Standard Electroweak Model are written as functions of the quark mass matrices, and their CP properties are emphasized. The formalism is applied to the problem of the electric dipole moment of the quark. The connection between the determinant of the commutator of mass matrices and the renormalization of the theta-parameter of QCD is discussed. ESA

N86-31354# Stockholm Univ. (Sweden). Inst. of Physics.
THE F MESON
K. E. Johansson Jan. 1986 31 p
(USIP-86-01; ESA-86-97231) Avail: NTIS HC A03/MF A01

The experimental status of the F meson is reviewed. As its measurements are exceptionally difficult, mainly because of the complex ambiguity problems and the small F cross section, the results are not always very significant, and can be contradictory. Measurement of the F mass results in very different values, varying from 2040 to (1971 +or- 5) MeV/sqcm. The lifetime is not very precisely determined, but is estimated at (1 to 4) x 10 to the minus 13th power sec. ESA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N86-31355# Los Alamos National Lab., N. Mex.
NUMERICAL PREDICTIONS OF RAILGUN PERFORMANCE

INCLUDING THE EFFECTS OF ABLATION AND ARC DRAG
N. M. Schnurr, J. F. Kerrisk, and J. V. Parker 1986 7 p Presented at the 3rd Symposium on Electromagnetic Launch Technology, Austin, Tex., 20-24 Apr. 1986
(Contract W-7405-eng-36)
(DE86-008718; LA-UR-86-861; CONF-8604147-1) Avail: NTIS HC A02/MF A01

Thermal radiation from plasma armatures in railguns may cause vaporization and partial ionization of the rail and insulator materials. This causes an increase in mass of the arc, which has an adverse effect on projectile velocity. Viscous drag on the arc also has a deleterious effect, particularly at high velocities. These loss mechanisms are modeled in the Los Alamos Railgun Estimator code. Simulations were performed and numerical results were compared with experimental data for a wide range of tests performed at the Los Alamos and Lawrence Livermore National Laboratories, the Ling Temco Vought Aerospace and Defense Company, and the Center for Electromechanics at the University of Texas at Austin. The effects of ablation and arc drag on railgun performance are discussed. Parametric studies illustrate the effects of some design parameters on projectile velocity and launcher efficiency. Some strategies for reducing the effects of ablation are proposed. DOE

N86-31356# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
EXPERIMENTAL AND THEORETICAL HIGH ENERGY PHYSICS Progress Report, 1 Jan. 1985 - 31 Dec. 1985
1986 30 p
(Contract DE-AC02-83ER-40105)
(DE86-009052; DOE/ER-40105/512) Avail: NTIS HC A03/MF A01

Progress is reported in these theoretical areas: duality in quantum chromodynamics; KNO scaling and violations at high energies; covariant confinement equation with screening; cosmic ray antiprotons produced by a heavy galactic halo of stable photinos; W boson pair production in supersymmetry; hadronic interactions at very high energies; field theory in curved space; string theory; high-temperature transition from weak to strong coupling in QCD and in grand unified models; and strong coupling phase transitions in supersymmetric grand unified models. Experimental high energy physics activities include: testing of grand unified and supersymmetric models of the fundamental interactions through a search for proton decay and other rare phenomena; study of quantum chromodynamics in high energy, large angle hadronic interactions; study of weak interactions with emphasis on CP violation in neutral kaon decay; and a search for fractionally charged particles. The foremost accomplishment is reported to be the apparent discovery of underground, high-energy radiation related to the X-ray binary Cygnus X-3. DOE

74 OPTICS

Includes light phenomena.

N86-31357*# Nevada Univ., Reno. Engineering Research and Development Center.
AERODYNAMICS OF SEEING ON LARGE TRANSPORT AIRCRAFT Progress Report, 1 Dec. 1985 - 31 May 1986
William C. Rose 31 May 1986 102 p
(Contract NCC2-382)
(NASA-CR-177035; NAS 1.26:177033) Avail: NTIS HC A06/MF A01 CSCL 20F

Data were obtained in the full scale flight environment of the Kuiper Airborne Observatory (KAO) on the nature of turbulent shear layer over the open cavity. These data were used to verify proposed aerodynamic scaling relationships to describe the behavior of the turbulent layers and to estimate the optical performance of systems of various wavelengths operating within the KAO environment. These data and wind tunnel data are used to scale the expected optical effects for a potential stratospheric observatory for infrared astronomy (SOFIA) in which a telescope approximately 3.5 times larger than that on the KAO is envisioned. It appears that the use of combinations of active and passive aeromechanical flow control techniques can improve the optical behavior of systems in the SOFIA environment. Experiments to verify these potential improvements can be performed on the KAO with sufficient modifications to the cavity and aero-mechanical technique installations. Author

N86-31358*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
DEVELOPMENT OF HIGH THROUGHPUT X-RAY TELESCOPES FOR X-RAY IMAGING AND DISPERSIVE SPECTROMETERS Semiannual Report, 1 Jul. 1985 - 30 Jun. 1986
Paul Gorenstein Aug. 1986 20 p
(Grant NsG-5138)
(NASA-CR-177074; NAS 1.26:177074; SAR-18; SAR-19) Avail: NTIS HC A02/MF A01 CSCL 20F

During the past year the technical approach to the realization of a high throughput Kirkpatrick-Baez X-ray mirror became better defined in terms of construction methodology and factors which affect maximum size. More progress was made than anticipated in the area of automatic figure formation. However, effort to improve the resolution of float glass by simple techniques were not successful. Mirror development, spectroscopy, all sky telescope, and explorer concept studies are discussed. B.G.

N86-31359# Dayton Univ., Ohio. Research Inst.
TECHNIQUES FOR OPTICAL INTERFERANEMOGRAPHY Final Report, 15 Sep. 1983 - 16 Jun. 1985
A. J. Lightman and S. Cartwright Dec. 1985 120 p
(Contract F33615-83-C-3020)
(AD-A165950; UDR-TR-85-101; AFWAL-TR-85-3098) Avail: NTIS HC A06/MF A01 CSCL 20/6

The suitability of available anemometry and interferometry systems for forming an optical interfranemography system has been evaluated. It was determined that a three-dimensional laser Doppler interferometer (LDA) should be able to provide the spatial and velocity resolution required. All standard interferometric systems measure the integrated index variation along the line of sight. Consequently, they do not provide spatial resolution and are only adequate in systems that are symmetric along the line of sight. If spatial resolution is required, a tomographic system can be used but the optical access required exceeds that commonly available in wind tunnels. To overcome these shortcomings a new interferometric technique was searched for. It was found that the Lau interferometer could be modified so that measurements were made in a restricted volume. The interferometer that was assembled and tested operated in a shearing mode. The system used a white light source, yielding a bright image, and the system is able to withstand severe vibrations without degrading the signal. The Lau interfereometer has been examined in detail and the theory of operation is presented. GRA

N86-31360# Science Applications International Corp., Tucson, Ariz.
ELECTRO-OPTICAL DEVELOPMENT SYSTEM Final Report, 16 Apr. 1984 - 30 Sep. 1985
Devon G. Crowe 27 Sep. 1985 51 p
(Contract DAAK70-84-C-0034)
(AD-A166546) Avail: NTIS HC A04/MF A01 CSCL 20/6

This final report describes the successful delivery of all required items under the contract, as well as additional work not originally anticipated at the time the proposal was written. The original statement of work called for the development of an integrated system utilizing micro-channel plate (MCP) image intensification of a solid-state detector array with C-mount interface to a small diameter cystoscope. Five complete PAIR (Portal Aperture Image Refocusing) units were built and delivered. This task required devising a sophisticated optical design utilizing nine optical

elements, in addition to a unique mechanical housing and coupling mechanism. GRA

N86-31361# Florida Univ., Gainesville. Dept. of Nuclear Engineering Sciences.
MULTIAPERTURE OPTICS Final Report, 15 Sep. 1984 - 14 Jan. 1986
Richard T. Schneider 1 Mar. 1986 81 p
(Grant AF-AFOSR-0304-84)
(AD-A167060; AFOSR-86-0233TR) Avail: NTIS HC A05/MF A01 CSCL 20/6

The basic principles of Multiaperture Optics are discussed. Based on the results generated under this program, certain applications for multiaperture optics were identified. The main features of an optical instrument based on the multiaperature principle are, that such a sensor will necessarily have to be small, and need to be a mass product. Large scale integration would have to be used to evaluate data collected and perform pattern recognition. It is a necessity to perform these functions in the sensor itself, using parallel input into the circuitry and experimental device has been built and tested. It is capable of recognizing simple shapes. The development of optical instruments, at least the photographic camera, was undoubtedly inspired by the then existing knowledge of the anatomy of the human eye. Therefore it is probably appropriate to try this approach again for the development of a new type of optical instrument based on the design of the insect eye. A brief description is given of the anatomy of the insect eye and an instrument is designed using similar components. GRA

N86-31362# Texas Technological Univ., Lubbock. Systems Lab.
SPACE-VARIANT OPTICAL SYSTEMS Annual Report, 30 Sep. 1984 - 30 Nov. 1985
John F. Walkup and Thomas F. Krile Jan. 1986 19 p
(Grant AF-AFOSR-0382-84)
(AD-A167275; AFOSR-86-0232TR) Avail: NTIS HC A02/MF A01 CSCL 20/6

Both analytical and experimental investigations of 1-D and 2-D coherent and incoherent space-variant optical processors have been conducted. The investigations included: (1) investigation of an improved measure of the degree of invariance of a linear system and its applications to piecewise isoplanatic space-variant systems; (2) a process for generalized linear filtering of 1-D signals; (3) investigation of a very fast architecture for performing optical multiplication of binary numbers and (4) techniques for both linear and nonlinear space-variant processing based on the bilinear transform. GRA

N86-31363# Los Alamos National Lab., N. Mex.
FRESNEL DIFFRACTION IN AN OPTICAL SYSTEM WITH FOCUSING
R. G. Wenzel 1985 5 p Presented at the 8th International Conference on Lasers, Las Vegas, Nev., 2 Dec. 1985
(Contract W-7405-eng-36)
(DE86-006044; LA-UR-86-400; CONF-851208-2) Avail: NTIS HC A02/MF A01

The migration of the axial intensity maximum from the geometrical focus toward the diffracting aperture, known as the focal shift, is explained in terms of the asymmetry of the Fresnel diffraction about focus. Conditions for the reversal or elimination of the focal shift are predicted. DOE

N86-31364# Army Armament Research and Development Command, Dover, N. J.
EFFECTS OF SURFACE MICROROUGHNESS IN ELLIPSOMETRY
E. L. Church and J. M. Zavada Dec. 1985 30 p Presented at the Workshop on Optical Fabrication and Testing, Tucson, Ariz., 18-22 Oct. 1976 Submitted for publication
(Contract DE-AC02-76CH-00016)
(DE86-008014; BNL-37051; CONF-761041-3; CONF-750993-4) Avail: NTIS HC A03/MF A01

We calculate the effects of surface roughness on the ellipsometric angles using plans-wave Rayleigh-Rice vector scattering theory. In the perturbation limit, these effects can be written in terms of weighted intergals over the power spectral density of the surface roughness. We present results in this limit for surfaces with arbitrary optical index and arbitrary two-dimensional roughness distributions, and then illustrate and assess them by considering four distinct limits: (1) deterministic roughness in the form of periodic corrugations; (2) statistical roughness with large transverse correlation lengths relative to the incident wavelength; (3) statistical roughness with small transverse correlation lenghts; and (4) highly reflecting surface materials. DOE

N86-31365# California Univ., Berkeley. Lawrence Berkeley Lab.
BASIC CONSIDERATIONS ON SURFACE OPTICAL NONLINEARITIES
P. Guyot-Sionnest, W. Chen, and Y. R. Shen Jan. 1986 3 p Presented at the 8th International Conference on Lasers, Las Vegas, Nev. 2-6 Dec. 1985
(Contract DE-AC03-76SF-00098)
(DE86-008378; LBL-20065; CONF-851208-4) Avail: NTIS HC A02/MF A01

The origins of the surface nonlinearity in surface second harmonic generation are discussed. It is shown that this second-order nonlinear optical process is characterized by a surface nonlinear susceptibility tensor containing both local and nonlocal contributions. DOE

N86-31366# Los Alamos National Lab., N. Mex.
GLOBAL COORDINATES AND EXACT ABERRATION CALCULATIONS APPLIED TO PHYSICAL OPTICS MODELING OF COMPLEX OPTICAL SYSTEMS
G. Lawrence, C. Barnard, and V. K. Viswanathan 1986 8 p Presented at the SPIE Technical Symposium on Applications of Artificial Intelligence, Orlando, Fla., 31 Mar. - 4 Apr. 1986
(Contract W-7405-eng-36)
(DE86-008751; LA-UR-86-1027; CONF-860366-3) Avail: NTIS HC A02/MF A01

Historically, wave optics computer codes have been paraxial in nature. Folded systems could be modeled by unfolding the optical system. Calculation of optical aberrations is, in general, left for the analyst to do with off-line codes. While such paraxial codes were adequate for the simpler systems being studied 10 years ago, current problems such as phased arrays, ring resonators, coupled resonators, and grazing incidents optics require a major advance in analytical capability. This paper describes extension of the physical optics codes GLAD and GLAD V to include a global coordinate system and exact ray aberration calculations. The global coordinate system allows components to be positioned and rotated arbitrarily. Exact aberrations are calculated for components in aligned or misaligned configurations by using ray tracing to compute optical path differences and diffraction propagation. Optical path lengths between components and beam rotations in complex mirror systems are calculated accurately so that coherent interactions in phased arrays and coupled devices may be treated correctly. DOE

N86-31367# National Bureau of Standards, Boulder, Colo.
PROGRESS IN THE DESIGN OF OPTICAL FIBER SENSORS FOR THE MEASUREMENT OF PULSED ELECTRIC CURRENTS
G. W. Day, L. R. Veeser, G. I. Chandler, and R. W. Cernosek 1986 13 p Presented at the Conference on Measurement of Electrical Quantities in Pulse Power Systems-2. Gaithersburg, Md., 5 Apr. 1986 Prepared in cooperation with Los Alamos National Lab, N. Mex. and Sandia National Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE86-007831; SAND-86-0498C; CONF-860384-6) Avail: NTIS HC A02/MF A01

The state of the art in the design of fiber sensors for pulsed electric currents is reviewed. Some of the more useful configurations are described and compared. Transfer functions are computed and used to illustrate the effect of linear birefringence and twisting on the characteristics of the sensors. The technique of annealing bend-induced birefringence is described and its present capabilities

indicated. An analysis of the ultimate limits to noise equivalent current is given, indicating that several orders of magnitude improvement should be obtainable. DOE

N86-31368# California Univ., Berkeley. Lawrence Berkeley Lab.
MULTILAYER REFLECTORS FOR THE EXTREME ULTRAVIOLET SPECTRAL REGION
J. B. Kortright Aug. 1985 17 p Presented at the 2nd International Synchrotron Radiation Instrumentation Conference, Standford, Calif., 29 Jul. 1985
(Contract DE-AC03-76SF-00098)
(DE86-008374; LBL-20135; CONF-850734-23) Avail: NTIS HC A02/MF A01

Reflectivity data from Al-Nb multilayers in the 300 to 450 A wavelength range at angles 20 to 50 deg from normal incidence are presented. Constructive interference between the 10 layer-pairs of this structure is observed. Multilayers deposited on a super-polished optical flat had a much higher reflectivity than those deposited on Si (111) wafers. Annealing multilayers on Si at 330(0)C for 3 hr further reduced their reflectivity. Measured peak reflectivities for the multilayer on the super-polished optical flat are 17% and less depending on the angle of incidence. The measured reflectivity is not more than half of that calculated using a model assuming sharp interfaces between elemental materials. The resolution of this device, lambda/(DELTA)lambda approx. = 6 to 7, is in good agreement with the calculated values. DOE

N86-31369# Kiruna Geophysical Inst. (Sweden).
EVIDENCE FOR A NEW INTENSITY FORMULA FROM STANDARD TABLES OF SPECTRAL LINE INTENSITIES
Bo Thelin and Sten Yngstroem Oct. 1985 9 p
(KGI-Preprint-085; ISSN-0349-2656; ESA-86-97224) Avail: NTIS HC A02/MF A01

It is shown that a formula for the intensity of optical emission lines is in very good agreement with experimental results reported in standard tables of spectral data. It is emphasized that the formula is consistent with main features of the spectrum of the Sun. The formula is: I(h nu) = C(h nu) x exp(-J/kT)/(exp(h nu/Kt)-1) where nu is the frequency of the atomic spectral line, J is the ionization energy of the atom, and C(h nu) is a product of factors given by the experimental design (apparatus and sample properties), and the transition probability rate of the atom in the sample. ESA

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N86-31370# Nagoya Univ. (Japan).
ANNUAL REVIEW: APRIL 1984 - MARCH 1985
K. Adati, ed., H. Amano, ed., J. Fujita, ed., M. Fujiwara, ed., Y. H. Ichikawa, ed., T. Kawamura, ed., H. Obayashi, ed., M. Otsuka, ed., and Y. Tomita, ed. Mar. 1985 229 p
(ISSN-0547-1567) Avail: NTIS HC A11/MF A01

Topics addressed include: design study of an R-device tokamak; research activities; radio frequency containment; high energy beam experiment; bumpy torus; high beta pinch plasmas; laser produced plasmas; inertial confinement fusion; atomic processes; theory and computation; and plasma diagnositics. A list of publications is given. B.G.

N86-31371# Georgia Inst. of Tech., Atlanta. School of Physics.
RECOMBINATION AND REACTIONS IN DENSE IONIZED GASES Final Report, 1 Jan. 1980 - 30 Jun. 1984
M. R. Flannery 10 Dec. 1985 26 p
(Grant AF-AFOSR-0055-80)
(AD-A166190; GIT-85-004; AFOSR-86-0082TR) Avail: NTIS HC A03/MF A01 CSCL 20/9

A list of publications of the research performed during the period 1/1/80-6/30/84 is provided. Theoretical research has been conducted a) on ion-ion recombination in high pressure plasmas, b) on the theory of Rydberg collisions with electrons, ions and neutrals, and c) on the theory of ion-molecule collisions at (1 eV-5 keV)/AMU. Papers in these topics (a)-(c) have been written up and published as papers already submitted to AFOSR. In particular, a new and basic theory of ion-ion recombination in a dense gas has been developed from basic microscopic principles. The recombination rate is provided as a function of gas density and time. The theory has been published in papers already submitted to AFOSR. Appendix A of this report contains the published chapter on Theory of Ion-Molecule collisions at (1 eV-50 keV)/AMU. GRA

N86-31372# Los Alamos National Lab., N. Mex.
REVERSED FIELD PINCH: PRESENT STATUS TO FUTURE POTENTIAL
J. M. DiMarco 1986 17 p Presented at the 13th Annual Energy Technology Conference and Exposition (ET '86), Washington, D.C., 17 Mar. 1986
(Contract W-7405-eng-36)
(DE86-006026; LA-UR-86-221; CONF-860303-3) Avail: NTIS HC A02/MF A01

This paper is divided into four sections. The first deals with the potential of the Reversed-Field pinch as cost effective reactor. The second gives the status of the experimental data base. The third section is a summary of cost optimized design. The fourth section is a proposal for a development path to fusion reactor prototypes. DOE

N86-31373# Los Alamos National Lab., N. Mex.
ZT-P: AN ADVANCED AIR CORE REVERSED FIELD PINCH PROTOTYPE
Kurt F. Schoenberg, C. J. Buchenauer, L. C. Burkhardt, L. D. Caudill, R. S. Dike, T. Dominguez, J. N. Downing, P. R. Forman, J. A. Garcia, A. J. Giger et al Jan. 1986 67 p
(Contract W-7405-eng-36)
(DE86-007204; LA-10593-MS) Avail: NTIS HC A04/MF A01

The ZT-P experiment, with a major radius of 0.45 m and a minor radius of 0.07 m, was designed to prototype the next generation of reversed field pinch (RFP) machines at Los Alamos. ZT-P utilizes an air-core poloidal field system, with precisely wound and positioned rigid copper coils, to drive the plasma current and provide plasma equilibrium with intrinsically low magnetic field errors. ZT-P's compact configuration is adaptable to test various first wall and limiter designs at reactor-relevant current densities in the range of 5 to 20 MA/m(2). In addition, the load assembly design allows for the installation of toroidal field divertors. Design of ZT-P began in October 1983, and assembly was completed in October 1984. This report describes the magnetic, electrical, mechanical, vacuum, diagnostic, data acquisition, and control aspects of the machine design. In addition, preliminary data from initial ZT-P operation are presented. Because of ZT-P's prototypical function, many of its design aspects and experimental results are directly applicable to the design of a next generation RFP. DOE

N86-31374# Science Applications International Corp., Boulder, Colo. Plasma Research Inst.
STABILIZATION OF MAGNETOHYDRODYNAMIC MODES BY APPLIED RADIOFREQUENCY WAVES
D. A. Dippolito and J. R. Myra Jan. 1986 47 p
(Contract DE-AC03-76ET-53057)
(DE86-008564; SAIC-85/1922; PRI-94) Avail: NTIS HC A03/MF A01

A kinetic theory describing the nonlinear interaction of radiofrequency waves with low frequency magnetohydrodynamic modes is presented. The calculation of the nonlinear force density on a fluid element includes both ponderomotive and sideband mode coupling terms and allows arbitrary rf wave polarization. Electromagnetic effects and wave-particle interactions are retained in the analysis. The influence of the nonlinear force on magnetohydrodynamic plasma stability is calculated self-consistently, and a generalized low mode number ballooning equation is obtained for paraxial magnetic mirror geometry. The low frequency stability problem is thereby shown to involve the coupling of four waves

and the system of governing equations is presented. Specialized limits of the general equations are discussed, and a physical interpretation of rf stabilization is given. It is shown that stability is enhanced by placing the antenna and conducting cavity walls close to the plasma surface. DOE

N86-31375# International Centre for Theoretical Physics, Trieste (Italy).
STABILITIES OF MHD ROTATIONAL DISCONTINUITIES
S. Wang Nov. 1984 9 p
(DE85-703231; IC-84/216) Avail: NTIS (US Sales Only) HC A02/MF A01

The stabilities of MHD rotational discontinuities are analyzed. The results show that the rotational discontinuities in an incompressible magnetofluid are not always stable with respect to infinitesimal perturbation. The instability condition in a special case is obtained. DOE

N86-31435*# Rice Univ., Houston, Tex. Dept. of Mechanical Engineering and Materials Science.
LASER TECHNIQUES FOR ARC JET PLASMA DIAGNOSTICS; CONTINUATION OF A FEASIBILITY AND DESIGN STUDY
F. A. Wierum *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 33 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 20I

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N86-31376 British Library Lending Div., Boston Spa (England).
ATOMISTIC STUDY OF STACKING FAULTS IN ORDERED NI SUB 3 Fe PHASE
M. D. Starostenkov, B. F. Demyanov, and N. V. Gorlov 1985 9 p Transl. into ENGLISH from Izvestiya VUZ Chernaya Metallurgiya (USSR), no. 10, 1985 p 74-78
(BLL-M-36717-(5828.4)) Avail: British Library Lending Div., Boston Spa, England

The variational method was used to determine the atomic configuration of a superstructural stacking fault occurring in ordered Ni3Fe phase during a/3 shear in direction <112> of one part of a crystal in relation to the other along a closely packed /111/-type plane. Calculations were conducted in approximation of the Morse potential. Author

N86-31377*# Stanford Univ., Calif. Dept. of Materials Science and Engineering.
COMPUTER SIMULATION OF SURFACE AND FILM PROCESSES Final Report, 1 May 1981 - 30 Apr. 1984
W. A. Tiller and M. T. Halicioglu 1 Nov. 1984 75 p
(Contract NCC2-125)
(NASA-CR-176966; NAS 1.26:176966; SU-DMS-85-R-1) Avail: NTIS HC A04/MF A01 CSCL 20L

All the investigations which were performed employed in one way or another a computer simulation technique based on atomistic level considerations. In general, three types of simulation methods were used for modeling systems with discrete particles that interact via well defined potential functions: molecular dynamics (a general method for solving the classical equations of motion of a model system); Monte Carlo (the use of Markov chain ensemble averaging technique to model equilibrium properties of a system); and molecular statics (provides properties of a system at T = 0 K). The effects of three-body forces on the vibrational frequencies of triatomic cluster were investigated. The multilayer relaxation phenomena for low index planes of an fcc crystal was analyzed also as a function of the three-body interactions. Various surface properties for Si and SiC system were calculated. Results obtained from static simulation calculations for slip formation were presented. The more elaborate molecular dynamics calculations on the propagation of cracks in two-dimensional systems were outlined. B.G.

N86-31378*# Wisconsin Univ., Madison. Applied Superconductivity Center.
THERMAL AND ELECTRICAL CONTACT CONDUCTANCE STUDIES Final Report, 1 Jun. 1983 - 31 Aug. 1985
S. W. VanSciver and M. Nilles 1985 146 p
(Grant NAG2-242)
(NASA-CR-177093; NAS 1.26:177093) Avail: NTIS HC A07/MF A01 CSCL 20L

Prediction of electrical and thermal contact resistance for pressed, nominally flat contacts is complicated by the large number of variables which influence contact formation. This is reflected in experimental results as a wide variation in contact resistances, spanning up to six orders of magnitude. A series of experiments were performed to observe the effects of oxidation and surface roughness on contact resistance. Electrical contact resistance and thermal contact conductance from 4 to 290 K on OFHC Cu contacts are reported. Electrical contact resistance was measured with a 4-wire DC technique. Thermal contact conductance was determined by steady-state longitudinal heat flow. Corrections for the bulk contribution ot the overall measured resistance were made, with the remaining resistance due solely to the presence of the contact. Author

N86-31379# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
REACTIONS OF LASER-GENERATED FREE RADICALS AT SEMICONDUCTOR SURFACES Final Report, 1 Oct. 1982 - 30 Sep. 1985
Jeffrey I. Steinfeld 25 Nov. 1985 7 p
(Grant AF-AFOSR-0007-83)
(AD-A166233; AFOSR-86-0103) Avail: NTIS HC A02/MF A01 CSCL 07/4

Reactions of laser-generated free radicals at semiconductor surfaces have been investigated by photoelectron spectroscopy of adsorbed surface layers and by laser induced fluorescence detection of the gas-phase species. Systems investigated include dissociative chemisorption of XeF2 and CF3 on Si(111), IR multiple photon dissociation of alkylsilanes and characterization of SiH2. Theoretical calculations of spectroscopic, structural, and thermodynamic properties of reactive free radical intermediates have also been undertaken. GRA

N86-31380# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A NEW MATERIAL WITH GREAT PROSPECT: RAPIDLY SOLIDIFIED MICROCRYSTAL MATERIAL
Shi-Xun Zhang 17 Mar. 1986 6 p Transl. into ENGLISH from Jin Shu Re Chu Li (China), no. 1(n77), 1984 p 15-16
(AD-A166304; FTD-ID(RS)T-1155-85) Avail: NTIS HC A02/MF A01 CSCL 20/2

The main characteristics of the rapidly solidified microcrystal material are: 1) It has a very fine and homogeneous structure. When the cooling rate is 100,000 - 1,000,000 C/s, the size of the crystal grain is about 0.5 to a few micrometers. Its partial resolution is very small. The range of the partial resolution, and the distance between each crystal branch arm is about 0.5-5 micrometers. As the cooling rate increases, the crystal grain can be further refined and the partial resolutin can be further reduced or even eliminated. Because of the very fine and homogeneous structure, the microcrystal material has very good mechanical properties. Compared with ordinary materials, its strength and ductility, stress and corrosion resistance, fatigue fracture resistance, and high temperature oxidation resistance are much higher. 2) The solid solubility is enhanced remarkably. Due to the high cooling rate, the solid solubility of the rapidly solidified material can be increased remarkably. By using the rapid solidification technique, we not only can obtain a high strength material, but more importantly we can also add some metal elements into the metal

alloys, which have some special properties and cannot be obtained ordinarily. GRA

N86-31381# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION ON GROWTH AND LASER PROPERTIES OF GGG:(Nd,Cr) SINGLE CRYSTALS
Lehui Zhang, Chengtian Lin, Hairun Liu, Lin Liu, and Huanan Zhu 4 Apr. 1986 15 p Transl. into ENGLISH from Zhong Guo Jiguang (China), v. 11, no. 6, 1984 p 347-351
(Contract F33657-84-D-0165)
(AD-A166392; FTD-ID(RS)T-0002-86) Avail: NTIS HC A02/MF A01 CSCL 20/2

Investigation on the growth and laser properties of gadolinium gallium garnet crystal doped with neodymium and chromium is reported. As the segregation coefficient of Nd in GGG is less than 1 and that of Cr is greater than 1, a modified Czochralski method for growth is adopted in order to keep the dopants being uniform in the grown crystal. GRA

N86-31382# Advanced Research and Applications Corp., Sunnyvale, Calif.
SCANNING PHOTOVOLTAGE TECHNIQUE FOR HIGH RESOLUTION NON-DESTRUCTIVE CHARACTERIZATION OF SEMICONDUCTOR WAFERS Final Report, 2 Jul. 1984 - 2 Jan. 1985
L. J. Palkuti and A. A. Milgram Oct. 1985 42 p
(Contract F33615-84-C-5088)
(AD-A166864; ARACOR-FR-85-351-1; AFWAL-TR-86-4043) Avail: NTIS HC A03/MF A01 CSCL 20/12

Near-surface defects in semiconductor wafers have a primary influence upon device properties, both, the yield and radiation hardness. In phase I of this program, a scanning photovoltage (SPV) technique was experimentally evaluated for the high-resolution, non-destructive identification and mapping of near-surface defects in wafers. The SPV technique shows promise of being useful for this purpose in semi-insulating materials such as GaAs, silicon-on-sapphire and InP. All the goals in the Phase I program were met; experimental apparatus was developed and the differential SPV signal correlated with surface dislocation networks in GaAs wafers. The results strongly support the development and further evaluation of the SPV techniques. The apparatus utilizes an Ar-ion scanning laser system with a programmable x-y table and a focussed laser beam. A photovoltage signal is measured due to the modulated laser beam. Author (GRA)

N86-31383# Honeywell Systems and Research Center, Minneapolis, Minn.
SUPERLATTICE OPTICAL BISTABILITY RESEARCH Semiannual Report, 1 Oct. - 30 Dec. 1985
Mohammad M. Tehrani 31 Jan. 1986 5 p
(Contract F49620-84-C-0071)
(AD-A167163; AFOSR-86-0166TR) Avail: NTIS HC A02/MF A01 CSCL 20/6

This report summarizes our progress and results during this reporting period. Our experiments show that the growth of thick (approx 5 micrometers) superlattice samples of HgTe/CdTe requires the use of a molecular beam epitaxy (MBE) system with in situ diagnostic capability to assure stability of growth parameters for periods of several hours. Our efforts with our in house MBE system have not succeeded in growing thick superlattice samples needed for the optical experiments. GRA

N86-31384# Honeywell Systems and Research Center, Minneapolis, Minn.
SUPERLATTICE OPTICAL BISTABILITY RESEARCH Quarterly Technical Report, 1 Jul. - 30 Sep. 1985
Mohammad M. Tehrani 30 Sep. 1985 4 p
(Contract F49620-84-C-0071)
(AD-A167176; AFOSR-86-0165TR) Avail: NTIS HC A02/MF A01 CSCL 13/8

The automation of Molecular Beam Epitaxy (MBE) system shutters was completed for the substrate and the Mercury, Cadmium Telluride and Telluride sources. As reported earlier, the automated shutter operations allow for much more precise thickness control of the superlattice layers during the deposition. Also, from signal-to-noise considerations, performing the nonlinear optical experiments requires the use of thick (>2 micrometer) superlattice samples which involve several hundred layers of Mercury Telluride and Cadmium Telluride. This can best be accomplished by using an automated Molecular Beam Epitaxy system. The current superlattice design calls for alternate layers of HgTe and CdTe with thicknesses of 100-150 A. A p-type sample with this structure is expected to yield a third order susceptibility (x(3)) of 100 times larger than that of the bulk HgCdTe. A number of test runs were carried out with the automated MBE system. These runs resulted in five superlattice samples of various thicknesses. One sample is now being used in a preliminary experiment of optical phase conjugation to establish baseline data. GRA

N86-31385# Utah Univ., Salt Lake City. Dept. of Physics.
STRUCTURAL INSTABILITIES, IMPURITIES AND DEFECTS IN ELECTRONIC MATERIALS Final Report, 15 Aug. 1983 - 14 Aug. 1985
P. C. Taylor 14 Aug. 1985 39 p
(Contract N00014-83-K-0535)
(AD-A167272) Avail: NTIS HC A03/MF A01 CSCL 20/12

The research supported under the present contract has been directed toward an understanding of some basic optical properties in materials of potential importance to the development of electronic devices. One important class of materials studied has been thin films of III-V semi-conductors which are grown using organometallic transport gases. These materials have been investigated using both individual layers and multiple-layer structures. In the layer structures, some effects due to the quantum confinement of electrons have been studied. A second class of materials studied has been amorphous semiconductors. In this class of solids we have investigated diffusion of impurities in oxide glass and amorphous silicon films. Research has also been performed on the effects of light on the optical and structural properties of thin layers of chalcogenide glasses. GRA

N86-31386# Harry Diamond Labs., Adelphi, Md.
PHYSICAL PROCESSES ASSOCIATED WITH RADIATION-INDUCED INTERFACE STATES
Peter S. Winokur, F. Barry McLean, and H. Edwin Boesch, Jr. Apr. 1986 27 p
(AD-A167280; HDL-TR-2081) Avail: NTIS HC A03/MF A01 CSCL 07/4

The buildup of interface states in Al-Si02-Si metal oxide semiconductor capacitors following exposure to pulsed electron beam irradiation has been previously shown to be a two-stage process. In the present work, we further examined the buildup by varying the polarity and magnitude of the field across the oxide during the two stages of the buildup. Specifically, both early (.000001 to 1 s) and late (1 to 10000 s) time regimes are explored. An empirical model of radiation-induced interface states at the Si02/Si interface is presented. The formulation, which explicitly addresses the time-dependent two-stage nature of the buildup process, gives the mathematical dependencies of the experimentally observed buildup on time, field, temperature, and dose. Along with the results of the field-switching experiments, the implications of the empirical model for the microscopic mechanisms involved in the buildup are discussed. In particular, the first stage is attributed to positive ion release in the bulk of the oxide via interactions with radiation-generated holes. The second stage is then associated with the transport of the liberated ions to the Si02/Si interface (for positive gate bias) where a subsequent interaction results in the appearance of electrically observable interface states. GRA

N86-31387# Auburn Univ., Ala.
SEMICONDUCTOR ALLOY THEORY Final Report, 1 Sep. 1984 - 31 Dec. 1985
An-Ban Chen 14 Jan. 1986 38 p
(Grant AF-AFOSR-0282-84)
(AD-A167306; AFOSR-86-0160TR) Avail: NTIS HC A03/MF A01

CSCL 11/6

This grant supported our work on semiconductor alloy theory. Many useful results have been obtained, including; (1) generalization of Brooks' formula for alloy-scattering limited electron mobility to including multiple bands and indirect gaps, (2) calculation of SiGe alloys band structure, electron-mobility and core-exciton binding energy and linewidth, (3) comprehensive calculation of bond energy, bond length and mixing enthalpy for all III-V and II-VI pseudo-binary alloys, (4) development of a statistical theory which shows a non-random distribution of atoms in most alloys, (5) studying the sensitivity of defect levels to band structures and impurity potentials, (6) a study of the dipolar contribution to the mixing energy and its implication to the long-range order in alloys, e.g., GaAlAs, and (7) a model which allows a simple but detailed calculation of alloy band-edge properties. GRA

N86-31388# Department of the Navy, Washington, D. C.
HETEROJUNCTION D(-) (OR A(+)) MILLIMETER AND SUBMILLIMETER WAVE DETECTOR Patent Application
Ben V. Shanabrook and William J. Moore, inventors (to Navy) Filed 27 Nov. 1985 16 p
(AD-D012309; US-Patent-Appl-SN-802286) Avail: NTIS HC A02/MF A01 CSCL 20/12

A solid state detector for use in detecting submillimeter and millimeter for wave radiation. The solid state detector comprises a semilattice of alternating thin epitaxial layers of GaAsl and AlGaAs doped with impurities having the same conductivity type. Because of the transfer of charge carriers in order to obtain thermal equilibrium, the charge carriers in the higher energy doped layer transfer to the adjacent lower energy doped layer and form a predetermined number of either D- or + centers in this layer. This D- or A+ center formation is obtained without the use of an optical bias. The ionization energy for these D- or A+ centers is small enough that photons from millimeter or submillimeter wave radiation is sufficient to ionize these carriers and yield a measurable conductivity in the device. GRA

N86-31389# Massachusetts Inst. of Tech., Cambridge. National Magnet Lab.
BASIC STUDIES OF SUBMICRON LAYERS OF Nb-Al Progress Report
1986 9 p
(Contract DE-FG02-85ER-45206)
(DE86-006985; DOE/ER-45206/2) Avail: NTIS HC A02/MF A01

Recent work with powder metallurgy processed Nb-Al has shown that thin layers of extruded Nb and Al reacted at low temperatures can form superconducting Nb-Al with high transition temperatures well above that expected from the equilibrium phase diagram for Nb-Al and high critical current densities. The basic mechanisms for the low temperature reaction and the importance of surface effects, impurities, and the dependence of layer thickness in Nb-Al are not understood. Purpose of the research program is a basic study of model layered structures of Nb and Al in order to develop an understanding of the basic properties of low temperature reacted Nb-Al. The research employs bilayers and multilayers of Nb and Al to study the effects of layer structures, oxygen, third element additives, proximity, and mechanisms for high critical currents in thin layers. In a controlled manner, the model systems can be studied and analyzed, and made to approach the actual systems produced by powder processing techniques. DOE

N86-31390# Sandia National Labs., Albuquerque, N. Mex.
MONTE CARLO STABILITY ANALYSIS OF STRAINED LAYER SUPERLATTICE INTERFACES
B. W. Dodson 1985 6 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985
(Contract DE-AC04-76DP-00789)
(DE86-007146; SAND-85-1403C; CONF-851217-50) Avail: NTIS HC A02/MF A01

We have developed a procedure, based on conventional Monte Carlo methods, to investigate the limits of stability of a strained layer superlattice (SLS) system as a function of lattice mismatch and layer thickness. The method is demonstrated by the analysis of two-dimensional Lennar-Jones SLS systems, for which the regime of absolute SLS stability is mapped out. Extension of the technique to three-dimensional silicon-like model systems is discussed, and appropriate model potentials for stability analysis of the Si/SiGe system are introduced. DOE

N86-31391# Material Progress Corp., Santa Rosa, Calif.
GROWTH OF LARGE GSGG CRYSTALS Final Report
F. J. Bruni Oct. 1985 19 p
(Contract W-7405-eng-48)
(DE86-006700; UCRL-15735) Avail: NTIS HC A02/MF A01

This report describes research intended to study the growth of crystals of gadolinium scandium gallium garnet (Gd3Sc2-Ga3O12) doped with neodymium and chromium. A specific goal of this project was to grow crystals 2.5 inches (6.4 cm) in diameter by 10 inches (25.4 cm) long with chromium and neodymium doping levels of 2 x 10(20) ions/cc each. The growth of undoped crystals of gadolinium scandium gallium garnet (GSGG) was studied as well in order to investigate the general engineering issues associated with the growth of GSGG crystals of this size. DOE

N86-31392# Pittsburgh Univ., Pa. Dept. of Metallurgical and Materials Engineering.
IN-SITU SAX INVESTIGATIONS OF ISOTHERMAL CRYSTALLIZATION IN POLY(TMPS) FRACTIONS
J. H. Magill, J. M. Schultz, and J. S. Lin Nov. 1985 46 p Presented at the American Physical Society Meeting, Baltimore, Md., 25 Mar. 1985 Prepared in cooperation with Delaware Univ., Newark and ORNL, Tenn.
(Contract DE-AC05-84OR-21400)
(DE86-003816; CONF-8503216-1) Avail: NTIS HC A03/MF A01

The isothermal crystallization kinetics of poly(TMPS) has been measured by ISSAXS and results obtained for a molecular weight fraction (21,000) below the critical entanglement molecular weight (25,000) and another one above it (371,000). The SAXS intensity vs time curves suggest that a single transformation mechanism exist. The SAXS long period is independent of crystallization time for both poly(TMPS) fractions. However, the interlamellar thickness contribution to the long period is dependent upon molecular weight and crystallization temperature, increasing with temperature and molecular weight. The crystallite contribution also increases over the range studied. Both fractions exhibit a significant, but reversible decrease in thickness on cooling the sample from the crystallization temperature to room temperature and recycling again. The change is more pronounced for 371,000 specimen in keeping with its lower crystallinity. The path dependence of lamellar dimensions has significant implications in the morphological characterization of polymers annealed or crystallized at one temperature and then measured at another one. DOE

N86-31393# Cornell Univ., Ithaca, N.Y. Dept. of Materials Science and Engineering.
DIFFRACTION AND MICROSCOPY STUDIES OF THE STRUCTURE OF GRAIN BOUNDARIES IN Fe, Fe-BASE ALLOYS AND CERAMIC MATERIALS Final Technical Report
S. L. Sass Dec. 1985 13 p
(Contract DE-FG02-84ER-45152)
(DE86-007983; DOE/ER-45152/3) Avail: NTIS HC A02/MF A01

This is the final technical report for Contract No. FG02-84ER45152. The long range goal of this research project is to obtain information on the atomic structure of grain boundaries in bcc metals and ceramics, to understand how segregation influences grain boundary structure and causes boundaries to become embrittled in Fe-base alloys, to understand how segregation and the ionization state of the solute influences the boundary structure in ceramic materials, and to study faceting and the frequency of its occurrence in ceramic materials. Electron microscopy and electron diffraction techniques were used to carry out the studies on grain boundaries. Most of the work reported is on influence of Fe solute on the structure of grain boundaries in MgO. DOE

N86-31394# Sandia National Labs., Albuquerque, N. Mex.
MODIFICATION OF POINT DEFECTS IN QUARTZ FOR DEVICE APPLICATIONS
J. C. King and D. R. Koehler Feb. 1986 10 p
(Contract DE-AC04-76DP-00789)
(DE86-007988; SAND-85-2450) Avail: NTIS HC A02/MF A01

Impurity centers in quartz play a significant role in the behavior of precision crystal resonators subjected to ionizing radiation. The substitutional Al center, charge-compensated by Na, Li, H, or a hole, is now known to be the primary contributing factor in most radiation-induced effects. Acoustic loss measurements, electron spin resonance measurements, optical studies, and infrared studies of these defects, over extended temperature ranges, have contributed substantially to our understanding of the role of impurity centers. Radiation-induced frequency and acoustic loss changes in quartz-crystal resonators are now understood in terms of the evolving character of the defect center in a radiation field. This understanding has prompted such material modifications as high-temperature electrolysis and doping technologies that permit, for instance, the fabrication of frequency control devices that are little affected by hostile environments. DOE

N86-31395# Temple Univ., Philadelphia, Pa.
DYNAMIC ASPECTS OF THE DYE-SENSITIZED PHOTOCONDUCTIVITY OF SEMICONDUCTORS Final Technical Report, 1 Apr. 1984 - 31 May 1985
A. M. P. Goncalves 1985 7 p
(Contract DE-AC02-81ER-10881)
(DE86-007662; DOE/ER-10881/1) Avail: NTIS HC A02/MF A01

The work carried out in the current period was a continuation of that done previously under this contract. The goal was to elucidate the dynamics of the processes which determine the efficiency of dye-sensitized semiconductor/electrolyte photoelectrochemical cells. In particular, direct fluorescence lifetime measurements were undertaken to explore the competition between the primary event, electron transfer, and other processes which shorten the lifetime of the dye excited state. DOE

N86-31396# California Univ., Berkeley. Lawrence Berkeley Lab.
SCHOTTKY AND OHMIC Au CONTACTS ON GaAs, MICROSCOPIC AND ELECTRICAL INVESTIGATION
Zuzanna Liliental-Weber, R. Gronsky, J. Washburn, N. Newman (Stanford Univ., Calif.), W. E. Spicer, and E. R. Weber (California Univ., Berkeley.) Feb. 1986 25 p Presented at the Conference on Physics and Chemistry of Semiconductor Interfaces, Pasadena, Calif., 28-30 Jan. 1986 Submitted for publication
(Contract DE-AC03-76SF-00098)
(DE86-007610; LBL-21010; CONF-860159-1) Avail: NTIS HC A02/MF A01

Electrical device measurements and transmission electron microscopy (TEM) methods were used to investigate the electrical, morphological and structural properties of Au/GaAs Schottky diodes. The electrical charcteristics of Au diodes formed on automically clean and air-exposed GaAs (110) surfaces change from rectifying to ohmic behavior after annealing above the Au-Ga eutectic temperature (360(0)C), owing to an ohmic-like contact at the periphery of the device. TEM indicate that the ohmic peripheral current pathway can be correlated with the formation of near-surface Ga-rich Au crystallites at the diode circumference upon annealing. Removal of these Au crystallites by mesa-etching is also accompanied by the elimination of the ohmic current. The morphology of the overlayer depends strongly on annealing and surface treatment. The interface is flat and abrupt for all unannealed diodes, as well as for annealed diodes formed on atomically clean surfaces. For annealed diodes formed on the air-exposed surfaces, the metal-semiconductor interface contains large metallic protrusions extending up to several hundred Angstroms into the semiconductor. The morphology of annealed diodes formed using typical commercial processing technology (i.e., formed on chemically prepared (100) surfaces annealed in forming gas) was also investigated using TEM. The interface for these structures is more complex than interfaces formed on the atomically clean and air-exposed cleaved (110) surfaces. Au diffuses through the interfacial native oxide layer and forms islands in intimate contact with the semiconductor.DOE

N86-31397# Los Alamos National Lab., N. Mex.
GRAIN GROWTH PHENOMENA IN FILMS: A MONTE CARLO APPROACH
D. J. Srolovitz 1986 23 p Presented at the International Conference on Metallurgical Coatings, San Diego, Calif., 7-11 Apr. 1986 Submitted for publication
(Contract W-7405-eng-36)
(DE86-008755; LA-UR-86-1061; CONF-860495-2) Avail: NTIS HC A02/MF A01

A statistical model of microstructural evolution is developed for the evolution of grain structure during deposition. In cases where the atomic mobility on the surface greatly exceeds that in the bulk of the film, the bulk microstructure may be viewed as static while all of the evolution is controlled by the free surface. This leads naturally to a two-dimensional model of microstructural evolution. Since the surface is advancing at a constant rate during deposition there is a linear relationship between time in the two-dimensional model and depth in the film. A Monte Carlo computer simulation technique is described which models the evolution of microstructure in this way. Various driving forces are included. Simulated microstructures in the plane of the film and in the plane perpendicular to the free surface are shown. DOE

N86-31398# General Electric Co., Largo, Fla. Neutron Devices Dept.
CHARACTERIZATION OF THE IMPURITIES IN TUNGSTEN/SILICON-GERMANIUM CONTACTS
H. A. Gregg, Sr. 26 Mar. 1986 17 p
(Contract DE-AC04-76DP-00656)
(DE86-008791; GEPP-TIS-892) Avail: NTIS HC A02/MF A01

Secondary ion mass spectrometry and Auger electron spectrometry depth profiling were used to determine impurity distributions in sputter deposited tungsten films over N-type and P-type 80/20 silicon-germanium elements of thermoelectric devices. These analyses showed that silicon, oxygen, sodium, boron, and phosphorous were present as impurities in the tungsten film. All these impurities except oxygen and sodium came from the substrate. Oxygen was gettered by the tungsten films, while sodium was possibly the result of sample handling. Further, the results from this study indicate that an oxide build-up, primarily at the tungsten/silicon-germanium interface of the N-type materials, is the major contributor to contact resistance in thermoelectric devices. DOE

N86-31399# Stanford Univ., Calif. Electronics Labs.
SIPOS HETEROJUNCTION CONTACTS TO SILICON
Young H. Kwark and R. M. Swanson Feb. 1986 275 p
(Contract DE-AC04-76DP-00789)
(DE86-008879; SAND-85-7022) Avail: NTIS HC A12/MF A01

Deliberate introduction of controlled amounts of an oxygen-bearing species such as nitrous oxide into the deposition ambient normally used for chemical vapor deposition of polysilicon produces SIPOS, a class of silicon oxides that exhibits a wide range of physical properties is discussed. It is possible to tailor SIPOS film characteristics such as refractive index by altering the oxygen partial pressure in the deposition ambient. The addition of a dopant species converts these films from semi-insulating to a form that can be made sufficiently conductive after annealing to make them interesting for electronic applications. The potential for conveniently altering the effective mobility gap in this material suggests its use in heterojunction contact structures to silicon. Incorporation of these films into the emitter structure of an NPN bipolar transistor has been found to reduce the emitter saturation current fifty fold. This suppression of reverse injected hole transport has often been assumed to be the result of a wider gap in the SIPOS due to the presence of incorporated oxygen. However, this seems to be an oversimplification in view of microstructural studies that revealed a multi-phase structure consisting of a fine dispersion of silicon microcrystals embedded in an oxide-like matrix. DOE

N86-31400# Missouri Univ., Columbia. Research Reactor Facility.
INELASTIC SCATTERING IN CONDENSED MATTER WITH HIGH INTENSITY MOSSBAUER RADIATION Annual Report, 1 Mar. 1985 - 28 Feb. 1986
W. B. Yelon and G. Schupp Feb. 1986 9 p
(Contract DE-FG02-85ER-45200)
(DE86-007007; DOE/ER-45200/2) Avail: NTIS HC A02/MF A01

The past year has seen the completion of most of the design and construction phases of our instrument development and the beginning of our scientific investigations. Many technical difficulties relating to mechanical strains in the source cryostat and in the MICE detector assembly caused by cycling them between 300 and 100 K have been overcome. The scientific work has been highlighted by the performance of the MICE director and how it has allowed us to measure the asymmetry parameters in (183)W and (182)W much more reliably than in the past and by the high momentum resolution made possible with our intense sources as demonstrated by studies on Si. Quasielastic scattering in a liquid metal is planned as well as investigation of interference and time reversal parameters in (182)W (100 keV), (183)W (46.5 keV), (197)Au (77 keV), and (193)Ir (73 keV). Additional work on the TaS2 1T using the 46.5 keV transition in (183)W is also planned in an effort to explore the already-observed anomaly at the 79(0)C incommensurate to quasi-commensurate transition. DOE

N86-31401# Wisconsin Univ., Madison. Materials Science Center.
CRYSTALLIZATION OF SPUTTER DEPOSITED AMORPHOUS METAL THIN FILMS
R. E. Thomas, J. H. Perepezko, and J. D. Wiley 1985 16 p Presented at the AVS Tri-state Symposium on Surface Analysis and Thin Film Technology, Oconomowoc, Wisc., 1 Apr. 1985
(Contract DE-FG02-84ER-45096)
(DE86-008958; CONF-8504224-1) Avail: NTIS HC A02/MF A01

Au overlayers on W-Si can reduce the crystallization temperatures by 100(0)C. In this paper we report on further work done on the W-Si system. Using Differential Thermal Analysis (DTA) we have measured the crystallization temperature versus composition from approximately 5 at. % Si to 40 at. % Si. Additional overlayers of W, Cu, and Al have been investigated. Both the W and Cu overlayers appear to have little effect on the stability of the underlying W-Si, while the Al reduces the crystallization temperature by at least 100(0)C. These results reinforce the observation that the choice of overlayer plays a critical role in determining the overall stability of the metallization, and indicate that W-Si is a viable candidate for diffusion barriers on silicon. DOE

N86-31402# International Centre for Theoretical Physics, Trieste (Italy).
CORE LEVEL SHIFTS IN SEMICONDUCTORS: A STUDY OF THE ELECTROSTATIC MODEL
Xuefu Zhong Aug. 1984 11 p
(DE85-703224; IC-84/120) Avail: NTIS (US Sales Only) HC A02/MF A01

A different electrostatic model is proposed for core level shift calculation in semiconductors on the basis of a critical analysis of so called bond charge model by Bechstedt et al. The population of valence charge on anion and on cation is no longer a linear function of Phillips ionicity, f sub (i), and a set of additive covalent radii is used instead of a nonadditive one. A phenomenological expression is given for bond charge which decreases as ionicity, f sub (i), increases. The results are in agreement with experiments, and the reasons for errors are explained. DOE

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N86-31403# Stanford Linear Accelerator Center, Calif.
RESEARCH PROGRAM WITH NO MEASUREMENT PROBLEM
H. P. Noyes, C. Gefwert, and M. J. Manthey Jul. 1985 10 p Presented at the Conference on New Techniques and Ideas in Quantum Measurement Theory, New York, N.Y., 21 Jan. 1986 Prepared in cooperation with Suomen Akatemia, Helsinki (Finland) and New Mexico Univ., Albuquerque
(Contract DE-AC03-76SF-00515)
(DE86-006952; SLAC-PUB-3734; CONF-860147-1) Avail: NTIS HC A02/MF A01

The measurement problem of contemporary physics is met by recognizing that the physicist participates when constructing and when applying the theory consisting of the formulated formal and measurement criteria (the expressions and rules) providing the necessary conditions which allow him to compute and measure facts, yet retains objectivity by requiring that these criteria, rules and facts be in corroborative equilibrium. We construct the particulate states of quantum physics by a recursive program which incorporates the non-determinism born of communication between asynchronous processes over a shared memory. Their quantum numbers and coupling constants arise from the construction via the unique 4-level combinatorial hierarchy. The construction defines indivisible quantum events with the requisite supraluminal correlations, yet does not allow supraluminal communication. Measurement criteria incorporate c, h-bar, and m/sub p/ or (not and) G. The resulting theory is discrete throughout, contains no infinities, and, as far as we have developed it, is in agreement with quantum m echanical and cosmological fact. DOE

N86-31404# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
POSSIBLE VIOLATIONS OF THE RELATIVITY THEORY
J. Tiomno 1985 28 p In PORTUGUESE
(DE86-700611; CBPF-NF-001/85) Avail: NTIS (US Sales Only) HC A03/MF A01

A review of previous works of the author and collaborators on possible violations of the Theory of Relativity (SR) is made. It is shown that there is no contradiction of the predictions of the Lorentz Aether Theory, in the form presented in these papers, with existing experiments. Further experiments to detect these violations (or to confirm SR) are indicated. DOE

N86-31405# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
EINSTEIN'S SPECIAL RELATIVITY VERSUS LORENTZ'S AETHER THEORY
Waldyr Alves Rodrigues, Jr. and Jayme Tiomno 1984 21 p Prepared in cooperation with Univ. Estadual de Campinas (Brazil).
(DE86-700627; CBPF-NF-018/84) Avail: NTIS (US Sales Only) HC A02/MF A01

Conditions under which failures are expected of Einstein's relativity are examined. For this a comparison is made with Lorentz's Aether theory. Two classes of possible experiments to detect violation of special relativity are examined with corresponding theorems proving them to lead to negative results, contrary to the statements of the proponents. Possible sources of violation of relativity theory are examined. DOE

N86-31406# Oklahoma State Univ., Stillwater. Dept. of Physics.
OBTAINING THE EINSTEIN-HILBERT ACTION FROM A SUPERCONFORMAL THEORY
C. H. Pilot Jan. 1986 41 p
(Contract DE-FG05-85ER-40215)

(DE86-009007; DOE/ER-40215/T3) Avail: NTIS HC A03/MF A01

By breaking the superconformal group it is possible to obtain an Einstein-Hilbert type action starting from one quadratic in the curvatures. The Newtonian gravitational constant is interpreted as a ratio of order parameters; at present low energies, these approach constant values of inherent dimension (much like the magnetization in a ferromagnet). Radiative corrections are forwarded as the mechanism responsible for spontaneous symmetry breaking (SSB). DOE

N86-31407# Oklahoma State Univ., Stillwater. Dept. of Physics.

CONCERNING THE TRANSFORMATION BEHAVIOR OF FIELDS UNDER THE SUPERCONFORMAL SYMMETRIES

C. H. Pilot Dec. 1985 29 p

(Contract DE-FG05-85ER-40215)

(DE86-009008; DOE/ER-40215/T1) Avail: NTIS HC A03/MF A01

The transformation behavior of fields under external type symmetries (such as the superconformal group) is gone over emphasizing the formal distinction between the group transformations of fields and their Lie transformations (often called Lie derivatives). We show how some of the standard results ordinarily expected for the Poincare group have to be generalized if the full symmetries of the superconformal group are to be respected. As far as classical scalar field theories go only massless phi(4) theories are superconformally invariant. DOE

N86-31408# Lawrence Livermore National Lab., Calif.

COMPUTATION OF ADIABATIC FLAME TEMPERATURES AND OTHER THERMODYNAMIC QUANTITIES

C. K. Westbrook 15 Apr. 1986 30 p Presented at the Symposium on Industrial Combustion Technology, Chicago, Ill., 29 Apr. 1986

(Contract W-7405-eng-48)

(DE86-009388; UCRL-94450; CONF-8604156-1) Avail: NTIS HC A03/MF A01

The equilibrium final temperature and composition of a given fuel-oxidizer mixture have both theoretical and practical importance for helping to understand the behavior of combustion systems. Both are needed in order to estimate levels of chemical pollutants such as oxides of nitrogen (NO sub x), and the final temperature is necessary to predict the expected thermal efficiency and heating value of a given combustor. Knowledge of the ways that various radical and stable intermediate chemical species vary as operating conditions are changed can also suggest system modifications to improve overall performance. In this paper, the methods available for computing chemical equilibrium conditions such as adiabatic flame temperatures will be reviewed. The dependence of computed values on available thermochemical data bases will be demonstrated. Examples of equilibrium flame temperatures and compositions for mixtures of interest and importance in natural gas combustion will be presented. DOE

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N86-31409*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

NASA/AMERICAN SOCIETY FOR ENGINEERING EDUCATION (ASEE) SUMMER FACULTY FELLOWSHIP PROGRAM, 1985

Robert G. Chilton, ed. (Texas A&M Univ., College Station.) and Clarence E. Williams, ed. Jul. 1986 733 p Program held in Houston, Tex., 1985

(Grant NGT-44-001-800)

(NASA-CR-171931; NAS 1.26:171931) Avail: NTIS HC A99/MF E03 CSCL 05I

The 1985 NASA/ASEE Summer Faculty Fellowship Research Program was conducted by Texas A&M University and the Johnson Space Center. The ten week program was operated under the auspices of the American Society for Engineering Education (ASEE). The faculty fellows spent the time at JSC engaged in research projects commensurate with their interests and background and worked in collaboration with NASA/JSC colleagues. This document is a compilation of the final reports of their research during the summer of 1985. For individual titles, see N86-31410 through N86-31436.

N86-31410*# Alabama Univ., Birmingham. Dept. of Physics.

MOSSBAUER SPECTROSCOPY OF EXTRATERRESTRIAL MATERIALS c25

David G. Agresti *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 10 p (For primary document see N86-31409 22-80)

Avail: NTIS HC A99/MF E03 CSCL 07D

Mossbauer Spectroscopy (MS) has recently been added to the tools used by Dr. Richard Morris of the Experimental Planetology Branch of the Solar System Exploration Division at Johnson Space Flight Center in his research on synthetic and natural analogs of lunar and Martian soils. A least-squares fitting program for MS data written originally for an IBM 360 Mainframe computer was adapted for use on an IBM-PC microcomputer. The adapted program has been applied to the analysis of MS spectra obtained from several samples of Antarctic soil under investigation at JSC as analogs to soil of the Martian regolith. Preliminary conclusions have been drawn from the MS data about the composition of the Antarctic samples. Inferences from optical spectra obtained for these same samples have been compared with the MS results.

Author

N86-31411*# Houston Univ., Tex. Dept. of Mechanical Engineering.

DESIGN CRITERIA FOR EXPERT SYSTEMS c61

Robert Allen *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 12 p (For primary document see N86-31409 22-80)

Avail: NTIS HC A99/MF E03 CSCL 09B

Knowledge based expert systems are applicable to a wide range of engineering problems ranging from formation to derivation. At the formation end of the spectrum, design, planning and prediction have been identified as generic tasks with similar issues that are dealt with by experts, and need to be formalized for successful expert system implementation. At the derivation end, diagnosis, interpretation and monitoring have been identified as generic tasks with similar subproblems with which experts must cope. At the implementation level, four levels of programming have been identified: logic programming, production system programming, object oriented programming and hybrid programming.

Author

N86-31412*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

EVALUATING SPACE STATION APPLICATIONS OF AUTOMATION AND ROBOTICS TECHNOLOGIES FROM A HUMAN PRODUCTIVITY POINT OF VIEW c54

Jonathan F. Bard *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 46 p (For primary document see N86-31409 22-80)

Avail: NTIS HC A99/MF E03 CSCL 05H

The role that automation, robotics, and artificial intelligence will play in Space Station operations is now beginning to take shape. Although there is only limited data on the precise nature of the payoffs that these technologies are likely to afford there is a general consensus that, at a minimum, the following benefits will be realized: increased responsiveness to innovation, lower operating costs, and reduction of exposure to hazards. Nevertheless, the question arises as to how much automation can be justified with the technical and economic constraints of the program? The purpose of this paper is to present a methodology which can be used to evaluate and rank different approaches to automating the functions and tasks planned for the Space Station. Special attention is given to the impact of advanced automation

on human productivity. The methodology employed is based on the Analytic Hierarchy Process. This permits the introduction of individual judgements to resolve the confict that normally arises when incomparable criteria underly the selection process. Because of the large number of factors involved in the model, the overall problem is decomposed into four subproblems individually focusing on human productivity, economics, design, and operations, respectively. The results from each are then combined to yield the final rankings. To demonstrate the methodology, an example is developed based on the selection of an on-orbit assembly system. Five alternatives for performing this task are identified, ranging from an astronaut working in space, to a dexterous manipulator with sensory feedback. Computational results are presented along with their implications. A final parametric analysis shows that the outcome is locally insensitive to all but complete reversals in preference. Author

N86-31413*# Houston Univ., Tex. Dept. of Applied Mathematical Sciences.

DISTRIBUTED SYNTHETIC APERTURE RADAR SIMULATION c32

Brian A. Bourgeois *In* NASA. Johnson Space Center NASA/American Society for Engineering Educaqtion (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 8 p (For primary document see N86-31409 22-80)

Avail: NTIS HC A99/MF E03 CSCL 17I

Synthetic aperture radar (SAR) depends primarily on attainable frequency resolution rather than on large physical size of the antenna array. The distributed architecture concept (DSAR) incorporates active elements (amplifiers) at or near the elemental radiators of the array. Since SAR's are expensive to build and expensive to test, a computer modeling approach is a feasible method of predicting the quality or nature of the SAR image from the proposed system parameters. The goal of this project is to produce a DSAR simulation software package. This report describes the progress made thus far and the work which remains to be done. Extensive work on this project had been done previously by two NASA contractors. The principal task remaining involved the creation of a suitable interface between these programs and the hardware and software available at the Johnson Space Center. Author

N86-31414*# Washington State Univ., Pullman. Dept. of Mechanical Engineering.

CONDENSATION HEAT TRANSFER UNDER A MICROGRAVITY ENVIRONMENT c34

L. C. Chow *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 24 p (For primary document see N86-31409 22-80)

Avail: NTIS HC A99/MF E03 CSCL 20D

A description of the condensation heat transfer process in microgravity is given. A review of the literature is also reported. The most essential element of condensation heat transfer in microgravity is the condensate removal mechanism. Two mechanisms for condensate removal are analyzed by looking into two problems. The first problem is concerned with film condensation on a flat porous plate with the condensate being removed by suction at the wall. The second problem is an analytical prediction of the heat transfer coefficient for condensing annular flows with the condensate film driven by the vapor shear. It is concluded that both suction and vapor shear can effectively drain the condensate to ensure continuous operation of the condensers operated under a microgravity environment. It is recommended that zero-g flight experiments be carried out to verify the prediction made in the present report. The results contained in this report should also aid in the design of future space condensers. Author

N86-31415*# Oregon State Univ., Corvallis.

CHRONOLOGY AND ISOTOPIC GEOCHEMISTRY OF APOLLO 14 BASALTS AND SKAERGARD GABBRO, EASTERN GREENLAND Final Report c91

E. Julius Dasch *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 6 p (For primary document see N86-31409 22-80)

Avail: NTIS HC A99/MF E03 CSCL 03B

Work completed on Apollo 14 basalts has been published. The two dates obtained from these rocks comprised the oldest and two of the three oldest ages (4.1 and 4.3 billion years) known for lunar maria basalts; thus their ages are important in understanding the moon's earliest history. Wing to the antiquity of these rocks, two more fragments have been dated as part of a second ASEE/NASA SFF program. The new ages are 3.95 and 4.12 billion years, thus further establishing and amplifying the earlier results. This work, although perhaps more interesting for its chronologic information, was begun as a test of chemical and petrographic models. Fragments of Apollo basalt were placed into five categories, based on petrologic and chemical, especially rare-earth element, composition. Isotopic studies were begun in an attempt to determine if the five groups of basalts were related by age or initial isotopic composition (isotopic composition of lava at time of extrusion). Although a few of the representatives of the five groups have the same age and/or initial strontium-isotopic composition, within the analtytical uncertainties, most apparently are unrelated. Petrologic implications of these data will be published in an appropriate journal. Author

N86-31416*# Hawaii Univ., Hilo. Dept. of Geography.

APPLICATION OF COMPUTER IMAGE ENHANCEMENT TECHNIQUES TO SHUTTLE HAND-HELD PHOTOGRAPHY c35

Bruce E. David *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 69 p (For primary document see N86-31409 22-80)

Avail: NTIS HC A99/MF E03 CSCL 14E

With the advent of frequent Space Transportation System Shuttle missions, photography from hyperaltitudes stands to become an accessible and convenient resource for scientists and environmental managers. As satellite products (such as LANDSAT) continue to spiral in costs, all but the most affluent consumer is finding Earth imagery from space to be more and more unavailable. Therefore, the potential for Shuttle photography to serve a wide variety of users is increasing. However, despite the popularity of photos from space as public relations tools and report illustrations, little work has been performed to prove their scientific worth beyond that as basic mapping bases. It is the hypothesis of this project that hand-held Earth photography from the Space Shuttle has potentially high scientific merit and that primary data can be extracted. In effect, Shuttle photography should be considered a major remote sensing information resource.

Author

N86-31417*# City Univ. of New York, N.Y. Bronx Community Coll.

INVESTIGATION OF LOCAL AREA NETWORKS FOR AN ORBITING SPACE STATION Final Report c62

Louis A. DeAcetis *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 4 p (For primary document see N86-31409 22-80)

Avail: NTIS HC A99/MF E03 CSCL 09B

An investigation and test of various equipment was conducted to determine its state of repair and suitability for use in a test-bed computer network (to be used to simulate a space station configuration of computers for control and monitoring). A research study was also made of various network types, including the IEEE network standards: (1) Carrier Sense Multiple Access with Collision Detection. (2) Token Passing Bus (3) Token Passing Ring, and (4) the draft ANSI standard for a High Speed Local Network, CSMA with Collision Avoidance. No firm conclusions are possible at this time as to which would be most suitable. An evaluation of the user interface of a space station database program, FREDSS (Formatted Retrieval and Entry of Data for Space Station, preliminary version), was also conducted and recommendations were made for possible improvements. Author

N86-31418*# Prairie View Agricultural and Mechanical Coll., Tex. Dept. of Electrical Engineering.

AN IBM PC-BASED MATH MODEL FOR SPACE STATION SOLAR ARRAY SIMULATION **c44**

Ervin M. Emanuel *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 28 p (For primary document see N86-31409 22-80)

Avail: NTIS HC A99/MF E03 CSCL 10A

This report discusses and documents the design, development, and verification of a microcomputer-based solar cell math model for simulating the Space Station's solar array Initial Operational Capability (IOC) reference configuration. The array model is developed utilizing a linear solar cell dc math model requiring only five input parameters: short circuit current, open circuit voltage, maximum power voltage, maximum power current, and orbit inclination. The accuracy of this model is investigated using actual solar array on orbit electrical data derived from the Solar Array Flight Experiment/Dynamic Augmentation Experiment (SAFE/DAE), conducted during the STS-41D mission. This simulator provides real-time simulated performance data during the steady state portion of the Space Station orbit (i.e., array fully exposed to sunlight). Eclipse to sunlight transients and shadowing effects are not included in the analysis, but are discussed briefly. Integrating the Solar Array Simulator (SAS) into the Power Management and Distribution (PMAD) subsystem is also discussed. Author

N86-31419*# New Mexico State Univ., Las Cruces. Dept. of Mechanical Engineering.

FIRE CONTROL METHOD AND ANALYTICAL MODEL FOR LARGE LIQUID HYDROCARBON POOL FIRES **c25**

Donald L. Fenton *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 14 p (For primary document see N86-31409 22-80)

Avail: NTIS HC A99/MF E03 CSCL 21B

The dominate parameter governing the behavior of a liquid hydrocarbon (JP-5) pool fire is wind speed. The most effective method of controlling wind speed in the vicinity of a large circular (10 m dia.) pool fire is a set of concentric screens located outside the perimeter. Because detailed behavior of the pool fire structure within one pool fire diameter is unknown, an analytical model supported by careful experiments is under development. As a first step toward this development, a regional pool fire model was constructed for the no-wind condition consisting of three zones -- liquid fuel, combustion, and plume -- where the predicted variables are mass burning rate and characteristic temperatures of the combustion and plume zones. This zone pool fire model can be modified to incorporate plume bending by wind, radiation absorption by soot particles, and a different ambient air flow entrainment rate. Results from the zone model are given for a pool diameter of 1.3 m and are found to reproduce values in the literature. Author

N86-31420*# Prairie View Agricultural and Mechanical Coll., Tex. Dept. of Mechanical Engineering.

DEVELOPMENT OF A NUMERICAL PROCEDURE TO MAP A GENERAL 3-D BODY ONTO A NEAR-CIRCLE **c64**

Mark J. Hommel *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 5 p (For primary document see N86-31409 22-80)

Avail: NTIS HC A99/MF E03 CSCL 12A

Conformal mapping is a classical technique utilized for solving problems in aerodynamics and hydrodynamics. Conformal mapping is utilized in the construction of grids around airfoils, engine inlets and other aircraft configurations. These shapes are transformed onto a near-circle image for which the equations of fluid motion are discretized on the mapped plane and solved numerically by utilizing the appropriate techniques. In comparison to other grid-generation techniques such as algerbraic or differential type, conformal mapping offers an analytical and accurate form even if the grid deformation is large. One of the most appealing features is that the grid can be constrained to remain orthogonal to the body after the transformation. Hence, the grid is suitable for analyzing the supersonic flow past a blunt object. The associated shock as a coordinate surface adjusts its position in the course of computation until convergence is reached. The present work applied conformal mapping to 3-D bodies with no axis of symmetry such as the Aerobraking Flight Experiment (AFE) vehicle, transforming the AFE shape onto a near-circle image. A numerical procedure and code are used to generate grids around the AFE body.Author

N86-31421*# East Carolina Univ., Greenville, N.C. Dept. of Biology.

EFFECTS OF LUNAR SOIL, ZAGAMI METEORITE, AND OCEAN RIDGE BASALT ON THE EXCRETION OF ITOIC ACID, A SIDEROPHORE, AND COPROPORPHYRIN BY BACILLUS SUBTILIS **c55**

Takeru Ito *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 12 p (For primary document see N86-31409 22-80)

Avail: NTIS HC A99/MF E03 CSCL 06C

Samples of lunar soil (10084,151), Zagami meteorite, postulated to be ejected from Mars, and ocean ridge basalt, the most abundant volcanic rock on earth, all completely inhibited the excretion of itoic acid and of coproporphyrin by Bacillus subtilis, a common airborne bacterium. Since such inhibition has been known to occur only under iron rich growth conditions(the excretion of these compounds occurs under iron deficient growth conditions), the result indicated that the organism was capable of extracting iron quite readily from these materials. A sample of synthetic ilmenite completely failed to inhibit the excretion of coproporphyrin, and inhibited the excretion of itoic acid only slightly. The result suggested that much of the iron extracted by the organism must have come from iron sources other than ilmenite,such as pyroxenes and olivines,in these natural materials tested. Author

N86-31422*# Utah Univ., Salt Lake City. Center for Occupational and Environmental Health.

DEFINING RECLAIMED WATER POTABILITY REQUIREMENTS **c54**

Daniel S. Janik *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 49 p (For primary document see N86-31409 22-80)

Avail: NTIS HC A99/MF E03 CSCL 06K

Water used during previous space missions has been either carried or made aloft. Future human space endeavors will probably have to utilize some form of water reclamation and recycling. There is little applied experience in either the US or foreign space programs with this technology. Water reclamation and recycling constitutes an engineering challenge of the broadest nature and will require an intensive research and development effort if this technology is to mature in time for practical use on the proposed US spacestation. In order for this to happen, reclaimed/recycled water specification will need to be devised to guide engineering development. Perhaps the most strigent specifications will involve water to be consumed. NASA's present Potable Water Specifications are not applicable to reclaimed or recycled potable water. No specifications for reclaimed or recycled potable water presently exist either inside or outside NASA. NASA's past experience with potable water systems is reviewed, limitations of the present Potable Water Specifications are examined, present world expertise with potable water reclamation/recycling systems and system analogs is reviewed, and an approach to developing pertinent Reclaimed/Recycled Potable Water Specifications for spacecraft is presented. Author

N86-31423*# LeTourneau Coll., Longview, Tex. Dept. of Chemistry.

REVIEW AND ANALYSIS OF HIGH TEMPERATURE CHEMICAL REACTIONS AND THE EFFECT OF NON-EQUILIBRIUM CONDITIONS **c25**

Richard E. Johnson *In* NASA. Johnson Space Center NASA/ American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 19 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 07D

Chemical reactions at high temperatures have been considered extensively because of their importance to the heating effects on re-entry of space vehicles. Data on these reactions however, are not abundant and even when found there are discrepancies in data collected by various investigators. In particular, data for recombination reactions are calculated from the dissociation reactions or vice versa through the equilibrium constant. This involves the use of the principle of detailed balancing. This principle is discussed in reference to conditions where it is valid as well as to those where it is not valid. Related topics that merit further study or for which applicable information was available are briefly mentioned in an appendix to this report. Author

N86-31424*# New Mexico Univ., Albuquerque. Dept. of Chemical and Nuclear Engineering.
AN ANALYSIS OF ULLAGE HEAT TRANSFER IN THE ORBITAL REFUELING SYSTEM **c34**
David Kauffman *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 74 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 20D

The Orbital Refueling System was an experiment flown on Shuttle Mission STS 41-G in October, 1984. Liquid hydrazine fuel was transferred back and forth from one spherical bladder tank to another using pressurized nitrogen as the driving force. Compressive heating of the ullage gas in the receiving tank could lead to a hazardous situation if any hydrazine leaked through to the ullage side of the bladder and was heated above about 175 F, where it can undergo spontaneous exothermic decomposition. Early analysis of the flight data indicated that the ullage compression process was much closer to an isothermal than an adiabatic one. In this study, a thorough review of the pertinent literature was used to make an a priori best-estimate for the ullage gas heat transfer coefficient (defining the Nusselt Number as a function of Reynolds and Rayleigh Numbers). Experimental data from the flight were analyzed in detail. It is evident that there is considerably more heat transfer than can be accounted for by conduction alone, but the observed increases do not correlate well with Reynolds Number, Rayleigh Number or vehicle acceleration. There are large gaps in the present understanding of convective heat transfer in closed containers with internal heat generation, especially in the presence of vibrations or other random disturbances. A program of experiments to fill in these gaps is suggested, covering both ground and orbital environments. Author

N86-31425*# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Electrical Engineering.
ENGINEERING GRAPHICS DATA ENTRY FOR SPACE STATION DATA BASE **c31**
R. C. Lacovara *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 13 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 13B

The entry of graphical engineering data into the Space Station Data Base was examined. Discussed were: representation of graphics objects; representation of connectivity data; graphics capture hardware; graphics display hardware; site-wide distribution of graphics, and consolidation of tools and hardware. A fundamental assumption was that existing equipment such as IBM based graphics capture software and VAX networked facilities would be exploited. Defensible conclusions reached after study and simulations of use of these systems at the engineering level are: (1) existing IBM based graphics capture software is an adequate and economical means of entry of schematic and block diagram data for present and anticipated electronic systems for Space Station; (2) connectivity data from the aforementioned system may be incorporated into the envisioned Space Station Data Base with modest effort; (3) graphics and connectivity data captured on the IBM based system may be exported to the VAX network in a simple and direct fashion; (4) graphics data may be displayed site-wide on VT-125 terminals and lookalikes; (5) graphics hardcopy may be produced site-wide on various dot-matrix printers; and (6) the system may provide integrated engineering services at both the engineering and engineering management level. Author

N86-31426*# Texas A&M Univ., College Station. Dept. of Biomedical Engineering.
ANALYSIS OF NYSTAGMUS RESPONSE TO A PSEUDORANDOM VELOCITY INPUT **c52**
Charles S. Lessard *In* NASA. Johnson Space Center NASA/ American Soceity for Engineering Eduction (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 104 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 06P

Space motion sickness was not reported during the first Apollo missions; however, since Apollo 8 through the current Shuttle and Skylab missions, approximately 50% of the crewmembers have experienced instances of space motion sickness. Space motion sickness, renamed space adaptation syndrome, occurs primarily during the initial period of a mission until habilation takes place. One of NASA's efforts to resolve the space adaptation syndrome is to model the individual's vestibular response for basis knowledge and as a possible predictor of an individual's susceptibility to the disorder. This report describes a method to analyse the vestibular system when subjected to a pseudorandom angular velocity input. A sum of sinusoids (pseudorandom) input lends itself to analysis by linear frequency methods. Resultant horizontal ocular movements were digitized, filtered and transformed into the frequency domain. Programs were developed and evaluated to obtain the (1) auto spectra of input stimulus and resultant ocular resonse, (2) cross spectra, (3) the estimated vestibular-ocular system transfer function gain and phase, and (4) coherence function between stimulus and response functions. Author

N86-31427*# Hawaii Univ., Honolulu. Dept. of Mechanical Engineering.
MATERIALS CONSIDERATIONS IN THE DESIGN OF A METAL-HYDRIDE HEAT PUMP FOR AN ADVANCED EXTRAVEHICULAR MOBILITY UNIT **c34**
Bruce E. Liebert *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 62 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 20D

A metal-hydride heat pump (HHP) has been proposed to provide an advanced regenerable nonventing thermal sink for the liquid-cooled garment worn during an extravehicular activity (EVA). The conceptual design indicates that there is a potential for significant advantages over the one presently being used by shuttle crew personnel as well as those that have been proposed for future use with the space station. Compared to other heat pump designs, a HHP offers the potential for extended use with no electrical power requirements during the EVA. In addition, a reliable, compact design is possible due to the absence of moving parts other than high-reliability check valves. Because there are many subtleties in the properties of metal hydrides for heat pump applications, it is essential that a prototype hydride heat pump be constructed with the selected materials before a committment is made for the final design. Particular care must be given to the evaporator heat exchanger worn by the astronaut since the performance of hydride heat pumps is generally heat transfer limited. Author

N86-31428*# Texas Univ., Galveston. Dept. of Internal Medicine.
FLOW CYTOMETRY ANALYSIS OF HORMONE RECEPTORS ON HUMAN PERIPHERAL BLOOD MONONUCLEAR CELLS TO

IDENTIFY STRESS-INDUCED NEUROENDOCRINE EFFECTS c52

Richard T. Meehan *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 7 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 06P

Understanding the role of circulating peptide hormones in the pathogenesis of space-flight induced disorders would be greatly facilitated by a method which monitors chronic levels of hormones and their effects upon in vivo cell physiology. Single and simultaneous multiparameter flow cytometry analysis was employed to identify subpopulations of mononuclear cells bearing receptors for ACTH, Endorphin, and Somatomedin-C using monoclonal antibodies and monospecific antisera with indirect immunofluorescence. Blood samples were obtained from normal donors and subjects participating in decompression chamber studies (acute stress), medical student academic examination (chronic stress), and a drug study (Dexamethasone). Preliminary results indicate most ACTH and Endorphin receptor positive cells are monocytes and B-cells, exhibit little diurnal variation but the relative percentages of receptor positive cells are influenced by exposure to various stressors and ACTH inhibition. This study demonstrates the capability of flow cytometry analysis to study cell surface hormone receptor regulation which should allow insight into neuroendocrine modulation of the immune and other cellular systems during exposure to stress or microgravity.

N86-31429*# McNeese State Univ., Lake Charles, La. Dept. of Electrical Engineerig.

AUTOMATION OF REVIEW/APPROVAL CYCLE OF MCAUTO CAD/CAM GENERATED DRAWINGS AND DOCUMENTS c61

Howard S. Minn *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 17 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 09B

The review/approval of MCAUTO/UNIGRAPHICS CAD/CAM generated drawings and documents is done through routing of hard copies of drawings and memos via mail, a process both time consuming and expensive. It is proposed that a set of procedures and the required software tools be designed for transmission, revision, and signing-off of such documents via electronic data transfer, while maintaining a sufficient degree of data integrity and individual security. A main resistance to such a technique will be the limited size of the display screen (19 inch class) and infrequent layer switching with the attendant time delay during the process of reviewing the drawing. Such opposition should diminish as the users become familiar with the hardwares and its operation. It is suggested that user profiles be set so that the protection class list of the originator of the drawing include at least one common class with each of the individuals who will be involved in the Revision/Approval cycle. In this way the originator will be able to tranfer a file for their review and also be able to copy back the file to make the necessary permanent changes. Individual security is maintained by restricted access to signature files and by restricting the list of individuals who will be authorized to sign off. This is accomplished through two software tools: LAYCOPY and SIGN. It is felt that these proposed procedures and techniques will adequately maintain both the file integrity and individual security during Review/Approval Cycle of MCAUTO generated drawings without the need for hardcopy routing. Author

N86-31430*# South Carolina Univ., Columbia. Dept. of Mechanical Engineering.

THERMALLY REGENERATIVE HYDROGEN/OXYGEN FUEL CELL POWER CYCLES c44

Jeffrey H. Morehouse *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 28 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 10B

Two innovative thermodynamic power cycles are analytically examined for future engineering feasibility. The power cycles use a hydrogen-oxygen fuel cell for electrical energy production and use the thermal dissociation of water for regeneration of the hydrogen and oxygen. The TDS (thermal dissociation system) uses a thermal energy input at over 2000 K to thermally dissociate the water. The other cycle, the HTE (high temperature electrolyzer) system, dissociates the water using an electrolyzer operating at high temperature (1300 K) which receives its electrical energy from the fuel cell. The primary advantages of these cycles is that they are basically a no moving parts system, thus having the potential for long life and high reliability, and they have the potential for high thermal efficiency. Both cycles are shown to be classical heat engines with ideal efficiency close to Carnot cycle efficiency. The feasibility of constructing actual cycles is investigated by examining process irreversibilities and device efficiencies for the two types of cycles. The results show that while the processes and devices of the 2000 K TDS exceed current technology limits, the high temperature electrolyzer system appears to be a state-of-the-art technology development. The requirements for very high electrolyzer and fuel cell efficiencies are seen as determining the feasbility of the HTE system, and these high efficiency devices are currently being developed. It is concluded that a proof-of-concept HTE system experiment can and should be conducted. Author

N86-31431*# Texas Univ., Houston. Dept. of Environmental Sciences.

CYTOGENETIC ANALYSES OF PERIPHERAL LYMPHOCYTES SUBJECTED TO SIMULATED SOLAR FLARE RADIATION c55

Howard M. Prichard *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 9 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 06R

Solar flare protons share many radiological health characteristics of the inner Van Allen Belt protons, and both types of radiation pose serious dangers to a number of missions planned. It is appropriate to evaluate crew dose determination procedures in terms of the type of radiation responsible for the major part of the projected exposure, i.e., protons in the neighborhood of 100 MeV Monitoring chromosome abnormalities in peripheral lymphocytes is one method to determine an individual's accumulated radiation dosage. Cell culture and harvest is a relatively simple procedure and is well within the capabilities of a station health facility, but the evaluation of prepared microscopic slides is a time consuming and subjective procedure. This project is part of an effort to demonstrate the utility of automated image processing and evaluation procedures in expediting dose evaluation. The initial goal of this project is to produce a set of reference chromosome spreads produced from control lymphocytes and from lymphocytes exposed in whole blood to protons or gamma rays. The results of manual and automated aberration scoring will ultimately be compared to test for systematic differences between the two evaluation procedures and between the two radiation qualities. Proton irradiations are performed at the University of Texas Health Science Center at Houston Cyclotron Facility. Proton dosimetry is supplemented by TLD packets from and by assay of short-lived proton activation products in the irradiation blood samples. Author

N86-31432*# Missouri Univ., St. Louis. Dept. of Computer Science.

INTEGRATION OF AN EXPERT SYSTEM INTO A USER INTERFACE LANGUAGE DEMONSTRATION c61

Daniel C. StClair *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 47 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 09B

The need for a User Interface Language (UIL) has been recognized by the Space Station Program Office as a necessary tool to aid in minimizing the cost of software generation by multiple users. Previous history in the Space Shuttle Program has shown that many different areas of software generation, such as operations, integration, testing, etc., have each used a different

user command language although the types of operations being performed were similar in many respects. Since the Space Station represents a much more complex software task, a common user command language--a user interface language--is required to support the large spectrum of space station software developers and users. To assist in the selection of an appropriate set of definitions for a UIL, a series of demonstration programs was generated with which to test UIL concepts against specific Space Station scenarios using operators for the astronaut and scientific community. Because of the importance of expert system in the space station, it was decided that an expert system should be embedded in the UIL. This would not only provide insight into the UIL components required but would indicate the effectiveness with which an expert system could function in such an environment.
Author

N86-31433*# University of Southeastern Louisiana, Hammond. Dept. of Biological Sciences.
IN VITRO CYTOGENETIC STUDIES OF ORGANIC CHEMICALS FOUND AS CONTAMINANTS IN SPACECRAFT CABIN ATMOSPHERES c45
Joseph Torres *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 6 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 13B

Astronauts can be exposed during spaceflight to organic chemical contaminants in the spacecraft cabin atmosphere. Toxic exposures may cause lesions in the cellular DNA which are subsequently expressed as sister-chromatid exchanges (SCE). Analysis of SCE is a sensitive short-term assay technique to detect and quantitate exposures to DNA-damaging (mutagenic) substances. The increase in SCE incidence over baseline (control) levels is generally proportional to the concentration of the mutagen and to the duration of exposure. Dichloromethane (methylene chloride) was chosen for this study since it occurred as an atmospheric contaminant in ten of the first 12 STS flights, and has been reported to have toxic and mutagenic effects in various test systems. Glutaraldehyde was chosen because relatively few data are available on the toxicity or mutagenicity of this common biological fixative, which is carried on STS flights for use in biological experiments. The BHK-21 baby hamster kidney cell line was the in vitro test system used in this study. Neither dichloromethane (10 ppm to 500 ppm) nor glutaraldehyde (1 ppm to 10 ppm) increased SCE levels following 20-hour exposure of BHK-21 cells to the test chemicals.
Author

N86-31434*# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Electrical Engineering.
CSTAR STAR CATALOGUE DEVELOPMENT c89
Jo A. Uhde-Lacovara *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 14 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 03A

The Continuous Stellar Tracking Attitude Reference (CSTAR) system is an in-house project for the Space Station to provide high accuracy, drift free attitude and angular rate information for the GN&C system. Constraints exist on the star catalogue incorporated in the system. These constraints include the following: mass memory allocated for catalogue storage, star tracker imaging sensitivity, the minimum resolvable separation angle between stars, the width of the field of view of the star tracker, and the desired number of stars to be tracked in a field of view. The Smithsonian Astrophysical Observatory (SAO) catalogue is the basis reference for this study. As it stands, the SAO does not meet the requirements of any of the above constraints. Star selection algorithms have been devised for catalogue optimization. Star distribution statistics have been obtained to aid in the development of these rules. VAX based software has been developed to implement the star selection algorithms. The software is modular and provides a design tool to tailor the catalogue to available star tracker technology. The SAO catalogue has been optimized for the requirements of the present CSTAR system.
Author

N86-31435*# Rice Univ., Houston, Tex. Dept. of Mechanical Engineering and Materials Science.
LASER TECHNIQUES FOR ARC JET PLASMA DIAGNOSTICS; CONTINUATION OF A FEASIBILITY AND DESIGN STUDY c75
F. A. Wierum *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 33 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 20I

This study is concerned with the continuation of a feasibility and design study of laser-based diagnostic techniques for the non-instrusive measurement of species concentrations, temperatures, and velocity in the low density, high enthalpy flow through the arc-heated wind tunnel facility (ARMSEF) at NASA/JSC. Last summer several laser-induced radiation scattering methods were investigated and some preliminary measurements of the spectral distribution of radiation emitted by the arc-heated gas flow were made. Based upon those preliminary measurements and subsequent investigations, four laser-induced radiation scattering methods were selected for further detailed study, and preliminary design of a measurement system has been undertaken. Further measurements of the spectral distribution of radiation emitted from the arc-heated free stream and shock layer flows, using a redesigned measurement system, have been made for one axial position in the flow for a range of tunnel operating power levels. Further study of the literature for physical property data, theoretical models of processes, and applications of the diagnostic methods has been also carried out.
Author

N86-31436*# Houston Univ., Tex. Dept. of Human Development.
SELECTION OF AN APPROPRIATE ANIMAL MODEL FOR STUDY OF BONE LOSS IN WEIGHTLESSNESS c55
Ira Wolinsky *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 7 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 06S

Prolonged weightlessness in space flight results in a slow progressive demineralization of bone accompanied by an increased calcium output in the urine resulting in negative calcium balances. This possibly irreversible bone loss may constitute a serious limiting factor to long duration manned space flight. A number of preventative measures have been suggested, i.e., exercise during flight, dietary calcium supplements, use of specific prophylactic drugs. In order to facilitate research in these areas it is necessary to develop appropriate ground-based animal models that simulate the human condition of osteoporsis. An appropriate animal model would permit bone density studies, calcium balance studies, biochemical analyses, ground-based simulation models of weightlessness (bed rest, restraint, immobilization) and the planning of inflight experiments. Several animal models have been proposed in the biomedical research literature, but have inherent deficiencies. The purpose of this project was to evaluate models in the literature and determine which of these most closely simulates the phenomenon of bone loss in humans with regard to growth, bone remodeling, structural, chemical and mineralization similarities to human. This was accomplished by a comprehensive computer assisted literature search and report. Three animal models were examined closely for their relative suitability: the albino rat, monkey, and Beagle.
Author

N86-31437*# Hampton Inst., Va.
HAMPTON UNIVERSITY/AMERICAN SOCIETY FOR ENGINEERING EDUCATION/NASA SUMMER FACULTY FELLOWSHIP PROGRAM 1986 Contractor Report, 2 Jun. - 8 Aug. 1986
John H. Spencer, comp. Sep. 1986 124 p
(Grant NGT-47-020-800)
(NASA-CR-178169; NAS 1.26:178169) Avail: NTIS HC A06/MF A01 CSCL 05I

Since 1964, the National Aeronautics and Space Administration (NASA) has supported a program of summer faculty fellowships for engineering and science educators. In a series of collaborations between NASA research and development centers and nearby universities, engineering faculty members spend 10 or 11 weeks working with professional peers on research. The Summer Faculty Program Committee of the American Society of Engineering Education supervises the programs. Objectives: (1) To further the professional knowledge of qualified engineering and science faculty members; (2) to stimulate and exchange ideas between participants and NASA; (3) To enrich and refresh the research and teaching activities of participants' institutions; (4) to contribute to the research objectives of the NASA center. Program Description: College or university will be faculty members appointed as Research Fellows to spend 10 weeks in cooperative research and study at the NASA-Langley Research Center. The Fellow will devote approximately 90 percent of the time to a research problem and the remaining time to a study program. The study program will consist of lectures and seminars on topics of general interest or that are directly relevant to the Fellows' research project. The lecturers and seminar leaders will be distinguished scientists and engineers from NASA, education or industry. Author

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N86-31438# Office of the Deputy Under Secretary of Defense for Research and Development (Research and Advanced Technology), Washington, D.C.

THE DEPARTMENT OF DEFENSE STATEMENT ON SCIENCE IN THE MISSION AGENCIES AND FEDERAL LABORATORIES BEFORE THE TASK FORCE ON SCIENCE POLICY OF THE COMMITTEE ON SCIENCE AND TECHNOLOGY OF THE UNITED STATES HOUSE OF REPRESENTATIVES, 99TH CONGRESS, FIRST SESSION

Donald I. Carter 2 Oct. 1985 23 p

(AD-A166041) Avail: NTIS HC A02/MF A01 CSCL 14/2

The DoD is supporting a vigorous Science and Technology program which is designed to assure the continued technological superiority of our defense systems. The program is planned to meet our critical needs and exploit technological opportunities. From basic research through development, our program successfully integrates the efforts of the university, industrial and in-house laboratory performers. Through attentive management and careful coordination we are maximizing the return on our S&T investment. We see areas which require our concern and attention to maintain the momentum of our S&T program. We are addressing the critical areas of science and engineering education and laboratory modernization. GRA

N86-31439# Office of the Deputy Under Secretary of Defense for Research and Development (Research and Advanced Technology), Washington, D.C.

THE DEPARTMENT OF DEFENSE STATEMENT ON SCIENCE IN THE SCIENCE AND TECHNOLOGY PROGRAM BEFORE THE SUBCOMMITTEE ON RESEARCH AND DEVELOPMENT OF THE COMMITTEE ON ARMED SERVICES OF THE UNITED STATES HOUSE OF REPRESENTATIVES, 99TH CONGRESS, SECOND SESSION

Ronald L. Kerber 12 Mar. 1986 46 p

(AD-A166042) Avail: NTIS HC A03/MF A01 CSCL 14/2

Topics discussed in the statement, promising opportunities are being explored in the non-medical aspects of biotechnology research to increase the efficiency and reduce costs in logistics functions, robotics and manufacturing sciences. The program is balanced to cover these and other revolutionary and evolutionary technologies essential for modernization of future forces. The Department is committed to ensuring that the Science and Technology (S&T) program is maintained at a viable level and that it will continue to be performed by a combination of industry, universities and DoD in-house laboratories. It is our view that this broad innovative base has served the country well and we will continue to depend upon it for the concepts, equipment and techniques needed for continued U.S. national security strength. GRA

N86-31440# Alphatech, Inc., Burlington, Mass.

HQ AFSC/TE (HEADQUARTERS, AIR FORCE SYSTEMS COMMAND DEPUTATE FOR TEST AND EVALUATION) RESOURCE MANAGER'S HANDBOOK

Steven R. Smith Apr. 1986 49 p

(Contract N00014-84-C-0458)

(AD-A166705; ACSC-86-2350) Avail: NTIS HC A03/MF A01 CSCL 05/1

This handbook will give the HQ AFSC/TE (Air Force Systems Command Deputate for Test and Evaluation) resource manager an abbreviated overview of the Planning, Programming, and Budgeting System (PPBS), AFSC implementation of PPBS, a discussion of AFSC's corporate review structure, an explanation of the documents used in the PPBS review process, and some resource manager's lessons learned in dealing with PPBS. This handbook is intended to be a starting point for newly assigned resource managers and a reference for fully trained resource managers and supervisors. The handbook will inform the resource manager concerning the PPBS process he will be involved in. GRA

N86-31441# Air Command and Staff Coll., Maxwell AFB, Ala.

A PRIMER FOR PROGRAM MANAGERS: EMBEDDED SOFTWARE ACQUISITION

Cecilia C. Albert Apr. 1986 40 p

(AD-A166731; AD-E801284; ACSC-86-0045) Avail: NTIS HC A03/MF A01 CSCL 15/5

Computer Software has become an ever increasing element in today's major defense system acquisitions. This study was written for the program manager with no software experience who is faced with the prospect of acquiring a major defense system which contains embedded software. It provides an overview of the software development process and a discussion of why things go wrong. Both the software development itself and the implications of the software on the system are considered. GRA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software.*

N86-31442# Department of Defense, Washington, D. C. Directorate for Information Operations and Reports.

DEFENSE ACQUISITION MANAGEMENT DATA SYSTEM CODE TRANSLATION MANUAL FISCAL YEAR 1985 Annual Report

1985 15 p

(AD-A165987; DIOR/MN04-85) Avail: NTIS HC A02/MF A01 CSCL 05/2

The first line of each entry identifies the contractor, the place of performance (city and state or country), the contractors unique identification number (DUNS code), and the codes (FIPS) for the place of performance. Data on each individual award to that contractor are then displayed on the following lines. This manual provides information on the meaning of the column headings which apply to those lines. This manual is intended to assist the user of these computer listings in understanding the range of data presented. While the meanings of many of the codes used in the listing are provided here, not all codes have been explained. Where applicable, references have been provided which identify other DIOR manuals and/or regulations that the reader may find useful. GRA

N86-31443# University of Southern California, Marina del Rey. Information Sciences Inst.
A GUIDE TO LEXICAL ACQUISITION IN THE JANUS SYSTEM
Susanna Cumming and Robert Albano Feb. 1986 82 p
(Contract MDA903-81-C-0335)
(AD-A166078; ISI/RR-85-162) Avail: NTIS HC A05/MF A01 CSCL 05/7

This document is a users' guide to LapItUp, the program which is used to add words to the Master Lexicon component of the JANUS natural language system, where syntactic, morphological, orthographic and semantic information particular to individual words and phrases is stored. The Master Lexicon is designed to serve all the lexical needs of the two grammars which form part of the JANUS system: RUS, an ATN parsing grammar, and Nigel, a systemic generation grammar. The user's guide contains a description of the organization of the Master Lexicon, instructions for adding words to the lexicon, and descriptions of each of the features that can be acquired using LapItUp. There are two important aspects to the Master Lexicon: the wordclass organization, which organizes the syntactic and morphological features used in lexical item specification, and the lexical item organization. In addition to a feature specification, the latter contains cross-indexing information or properties, semantic pointers, and record-keeping information. Lapitup uses the wordclass hierarchy to guide the use through a series of choices, presented in the form of menus of features with accompanying descriptive text. In addition, LapItUp contains facilities for acquiring morphological information, properties, and the other kinds of auxiliary information. GRA

N86-31444# Defense Technical Information Center, Alexandria, Va.
INFORMATION ANALYSIS CENTERS IN THE DEPARTMENT OF DEFENSE Final Report
M. C. Rothschild Apr. 1986 166 p
(AD-A167001; DTIC/TR-86/4) Avail: NTIS HC A08/MF A01 CSCL 05/2

The Department of Defense (DoD) Information Analysis Centers (IACs) have been assisting the research, development, and engineering efforts of the defense community for over forty years by analyzing, repackaging, and disseminating highly technical information in specialized subject areas to a select community. An overview of the IACs is presented, including an analysis of the IAC concept, followed by a brief history of the DoD IACs and an examination of some of the issues of concern to DoD IACs. IACs are not without their problems; nevertheless, they continue to have a significant role in the transfer of scientific and technical information. GRA

N86-31445# Defense Technical Information Center, San Diego, Calif. Matris Office.
DIRECTORY OF RESEARCHES FOR HUMAN RESEARCH AND DEVELOPMENT PROJECTS
1 May 1986 119 p
(AD-A167100) Avail: NTIS HC A06/MF A01 CSCL 05/2

The Directory of Researchers for Human Research and Development Projects lists individuals who perform and/or manage current people-related research and development for the Department of Defense. It is one of several documents produced at the Defense Technical Information System (MATRIS) office. MATRIS is an expanded information system that includes the data formerly contained in the Research and Development Information System (RDIS). This edition of the Directory of Researchers has been cosponsored and prepared with the support of the Office of the Assistant Secretary of Defense, Force Management and Personnel (OASD/FM&E), and the Office of the Under Secretary of Defense, Research and Engineering (OUSD/R&E) . GRA

N86-31446# Polydyne and Associates, Inc., San Mateo, Calif.
COST DATA MANAGEMENT SYSTEM, CDMS VERSION 2.2 Final Report
J. M. Weingart Dec. 1985 118 p
(Contract DE-AC04-76DR-00789)
(DE86-005064; SAND-85-8178) Avail: NTIS HC A06/MF A01

The Cost Data Management System (CDMS) is a cost data base computer program developed by Polydyne, Inc. and Associates for Sandia National Laboratories Livermore (SNLL). This program constitutes a unique and powerful tool for interactive development and documentation of complex cost data bases for power plants and other construction projects. This program is operational on the Digital Equipment Corporation's VAX computers operating under the latest version (4.1) of the VMS operating system. The original version of the CDMS (Version 1.1) has been extensively used by SNLL in the development, documentation, and analysis of the cost data base for Solar One. As a result of this work, a number of desirable enhancements to the CDMS were identified, and as a follow-on effort, Polydyne, Inc. has revised the original software. This report summarizes the extensive revisions and enhancements made to the CDMS, and discusses the features of the new program (CDMS Version 2.2). DOE

N86-31447# Oak Ridge National Lab., Tenn.
ISSUES IN DEVELOPING A DISTRIBUTED DATA ACQUISITION AND CONTROL SYSTEM
W. W. Manges 1986 4 p Presented at the 18th Southeast Symposium on System Theory, Knoxville, Tenn., 7 Apr. 1986
(Contract DE-AC05-84OT-21400)
(DE86-005491; K/AIS-5005; CONF-860479-2) Avail: NTIS HC A02/MF A01

This paper discusses issues and implications in the development of a minicomputer-based, distributed intelligence data acquisition and control system to support complex experimental facilities. Atomic Vapor Laser Isotope Separation is typical of programs that require the large-scale experimental facilities that have led to the design philosophy described in this paper. Incorporating computer systems in the instrumentation of ORNL's experimental facilities has increased productivity. However, several challenging issues must be addressed in developing such systems: (1) scientific as well as engineering goals; (2) ultimate goals with intermediate capabilities; (3) budget, scope, and schedule fluctuations; and (4) overlapping maintenance and development. The techniques and philosophy were used to provide the computer system hardware, software, architecture, and interfaces for the instrumentation and control system for large-scale developmental facilities which were developed for use at ORNL, but can be related to developing any large-scale experimental facility. DOE

N86-31448# Oak Ridge National Lab., Tenn. Fusion Energy Library.
INTEGRATED LIBRARY SYSTEM AT ORNL: LION
Ta-Chang Liu Mar. 1986 11 p
(Contract DE-AC05-84OR-21400)
(DE86-008867; DOE/OR-21400/T257) Avail: NTIS HC A02/MF A01

Viewgraphs describing the ORNL minicomputer system LION comprise the report. This library system provides information resources and services to support research and development activities. DOE

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

N86-31449# Committee on Appropriations (U. S. House).
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT-

INDEPENDENT AGECIES APPROPRIATIONS BILL, 1987
Boland Washington GPO 1986 84 p Presented by the Committee on Appropriations, 99th Congr., 2d Sess., 31 Jul. 1986 (H-Rept-99-731; GPO-61-562) Avail: US Capitol, House Document Room

The recommendations for the federal budget allocations for the Department of Housing and Urban Development and 17 independent agencies and offices are discussed. For individual titles, see N86-31450.

N86-31450# Committee on Appropriations (U. S. House).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
In its Department of Housing and Urban Development-Independent Agencies Appropriations Bill, 1987 1986 p 42-49 (For primary document see N86-31449 22-84)
Avail: US Capitol, House Document Room

Budget allocations for the orbital space station, space flight control and data communications, space shuttles, construction of new facilities, research and project management, Advanced Communications Technology Satellite (ACTS) program, space commercialization, and the shuttle infrared telescope facility (SIRTF) are discussed. B.G.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N86-31451*# National Aeronautics and Space Administration, Washington, D.C.
SPINOFF 1985
James J. Haggerty 1986 131 p
(NASA-TM-89240; NAS 1.15:89240) Avail: NTIS HC A07/MF A01 CSCL 05A

Mainline NASA programs, whose challenging objectives necessitate advances across a diverse scientific/technological spectrum are summarized. A representative selection of spinoff products and processes are presented and the NASA technology from which these transfers are derived, are described. The mechanisms NASA employs to foster technology utilization and stimulate interest among prospective users of the technology are detailed. B.G.

N86-31452*# Sverdrup Technology, Inc., Cleveland, Ohio.
EVALUATION OF A STIRLING ENGINE HEATER BYPASS WITH THE NASA LEWIS NODAL-ANALYSIS PERFORMANCE CODE Final Report
Timothy J. Sullivan May 1986 26 p
(Contracts NAS3-24105; DE-AI01-77CS-51040)
(NASA-CR-179460; DOE/NASA/4105-1; E-3113; NAS 1.26:179460) Avail: NTIS HC A03/MF A01 CSCL 10B

In support of the U.S. Department of Energy's Stirling Engine Highway Vehicle Systems program, the NASA Lewis Research Center investigated whether bypassing the P-40 Stirling engine heater during regenerative cooling would improve engine performance. The Lewis nodal-analysis Stirling engine computer simulation was used for this investigation. Results for the heater-bypass concept showed no significant improvement in the indicated thermal efficiency for the P-40 Stirling engine operating at full-power and part-power conditions. Optimizing the heater tube length produced a small increase in the indicated thermal efficiency with the heater-bypass concept. Author

N86-31453# Air Force Office of Scientific Research, Bolling AFB, Washington, D.C.
AFOSR (AIR FORCE OFFICE OF SCIENTIFIC RESEARCH) TECHNICAL REPORT SUMMARIES Quarterly Report, Oct. - Dec. 1985
Barbara J. Wert Dec. 1985 267 p
(AD-A166142; AFOSR-TR-86-0093) Avail: NTIS HC A12/MF A01 CSCL 05/2

The Air Force Office of Scientific Research Technical Report Summaries are published quarterly in March, June, September, and December of each calendar year. They consist of a brief summary of each AFOSR technical report received in the Technical Information Division and submitted to the Defense Technical Information Center (DTIC) for that quarter. The summaries contain two indexes for easily locating the technical reports that may be of interest to the user. These are followed by abstracts of the reports. The Subject index has a Subject field title of reports and AD number (Accession Number). The Personal author index has a Primary author, Title of Report and AD Number. The purpose of this report is to inform Air Force Laboratories about the science that the Air Force Office of Scientific Research is supporting. Examples of topics are: Ion Bombardment, Lasers, Air Flow, and Radar Reflections. GRA

N86-31454# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
FISCAL YEAR 1987 TECHNICAL OBJECTIVE DOCUMENT Annual Report, Jan. 1985 - Jan. 1986
Mar. 1986 115 p Supersedes AFWAL-TR-85-2000
(AD-A166659; AFWAL-TR-86-2000; AFWAL-TR-85-2000) Avail: NTIS HC A06/MF A01 CSCL 21/5

This Technical Objective Document was prepared to provide science and industry with specific technical objectives which the Air Force feels are critical to maintain aerospace superiority in the future. The TOD contains three functional areas (Aircraft, Missile and Space) which provide planning objectives covering the technical disciplines of airbreathing propulsion, aerospace vehicle power, fire protection, and aircraft and missile fuels and lubrication. GRA

N86-31455# Office of Naval Research, London (England).
EUROPEAN SCIENCE NOTES, VOLUME 40, NUMBER 5 Monthly Report
C. J. Fox May 1986 46 p
(AD-A166682; ESN-40-2-Vol-40-No-5) Avail: NTIS HC A03/MF A01 CSCL 05/2

European Science Note (ESN) is a monthly publication with brief articles on recent developments in European scientific research. This issue includes articles on the following topics: Neurobiology Research in Belgium; Plant Genetics Systems/ University/Industry Collaboration; Euromech 201. Applications of the mechanics of granular materials to geophysics; Fracture Research at the Fraunhofer-Gesellschaft for Werkstoffmechanik; Institut De soudre (The French Welding Institute); The first International Conference on Laser Anemometry; Turbulent Flow Meeting in Cardiff; INRIA Conference on Computing Methods in Applied Sciences and Engineering., Military Applied Laser Research at FIAR of Milan; Optoelectronics, Quantum Optics, Quantum Electronics and Instability Research in Florence; Science Policy -- Collaborative government-industry research at Fraunhofer-Gesellschaft. GRA

N86-31456# Air Force Human Resources Lab., Brooks AFB, Tex.
[SUMMARY OF THE TECHNICAL OBJECTIVES OF AIR FORCE EFFORTS IN THE FIELDS OF TRAINING AND PERSONNEL SYSTEMS TECHNOLOGY] Report, fiscal year 1987
Apr. 1986 36 p
(AD-A167348; AFHRL-TR-86-16) Avail: NTIS HC A03/MF A01 CSCL 05/9

This document provides the academic and industrial research and development community with a summary of the technical objectives of Air Force efforts in the fields of training and personnel systems technology. The areas covered are (a) manpower and

force management, (b) logistics technology, and (c) training technology. GRA

N86-31457# Wisconsin Board of Vocational, Technical and Adult Education, Madison.
WISCONSIN ELECTRIC AND HYBRID VEHICLE DEMONSTRATION PROJECT Final Report, 1981 - 1985
10 Feb. 1986 7 p
(Contract DE-FC08-81NV-10243)
(DE86-009318; DOE/NV-10243/1) Avail: NTIS HC A02/MF A01

In 1981, the Wisconsin Board of Vocational, Technical and Adult Education (WBVTAE) was selected by the US Department of Energy for participation in the National Electric and Hybrid Vehicle Demonstration Program. On September 30, 1985, the data collection phase of the project was completed. The project was to purchase ten (10) electric vehicles and assign five (5) to Northeast Wisconsin Technical Institute (NWTI) in Green Bay and five (5) vehicles to the Madison Area Technical College. DOE

N86-31458# Tennessee Valley Authority, Chattanooga. Div. of Energy Demonstrations and Technology.
ELECTRIC VEHICLE TRACTION BATTERY MODULE MONITOR TEST RESULTS FOR WYLE AND PROPEL SYSTEMS
R. K. Buffett and T. W. Blickwedel May 1985 96 p
(DE86-900543; TVA/OP/EDT-85/21) Avail: NTIS HC A05/MF A01

The Wyle and Propel units for monitoring parameters of the traction battery of electric vehicles were tested by the Tennessee Valley Authority (TVA). The monitors are designed to indicate modules that are providing significantly less energy than other modules in the battery pack and which therefore need maintenance or need to be replaced. Testing was performed on the bench, as a part of static load tests, and in vehicles. Both monitors sought to detect low energy capacity modules by measurement of pack current, evaluation of an equation, and comparison of the result with the actual voltage of each module. With the Wyle breadboard unit, the equation parameters were adjustable; whereas with the Propel unit, the equation parameters were not adjustable. Based on the results from static load tests, the Wyle monitor was deemed unacceptable due to numerous false alarms exhibited in its use. The Propel monitor detected low energy capacity modules and reliably indicated modules with a low electrolyte level. During static load tests, the pack voltage and current, as well as each module voltage, were recording using a digital computer, and results were compared with those displayed by the monitor under test. The monitors were tested in Volkswagen Electrotransporter electric vehicles for over one year. About 5989 miles were logged with the Wyle, and about 6015 miles were logged with the Propel DOE

N86-31459# Technische Physische Dienst TNO-TH, Delft (Netherlands).
[ACTIVITIES REPORT IN APPLIED PHYSICS] Annual Report 1983
1984 69 p In ENGLISH and DUTCH
(ESA-86-97387) Avail: NTIS HC A04/MF A01

Research concerning acoustics; heat; human environment; optical instrumentation; data processing and information systems; glass ceramics; and X-ray diffraction is described. A simulation model to predict noise transmission in open air; a method for speech intelligibility determination in halls and similar places; solar houses; a laser ranger to determine the distance to geodetic satellites; a simulation model of the pulping process in the paper industry; and a miniature echo-acoustic sensor for a small diving vessel are discussed. ESA

N86-31460# Kiruna Geophysical Inst. (Sweden).
[ACTIVITIES REPORT OF THE GEOPHYSICAL INSTITUTE] Annual Report, 1985
Lars Eliasson, ed. and Ingrid Sandahl, ed. 1986 52 p
(ISSN-0283-1686; ESA-86-97226) Avail: NTIS HC A04/MF A01

Research activities concerning hot plasmas (experimental studies using satellites, theoretical studies, and ionospheric and magnetospheric research based on sounding rocket experiments); computer simulation of plasma; and research based on ground based instrumentation (EISCAT, optical methods) are summarized. A laboratory for mechanical waves; and the program of the geophysical observatory are described. ESA

N86-31461# Amsterdam Univ. (Netherlands). Dept. of Science Dynamics.
EVALUATION OF RESEARCH: EXPERIENCES AND PERSPECTIVES IN THE NETHERLANDS
Stuart Blume, Henk Dits, Peter Groenewegen, Loet Leydesdorff, Ad Prins, Jan Willem Smeenk, Jack Spaapen, and Sjerp Zeldenrust Dec. 1984 47 p
(ESA-86-96709) Avail: NTIS HC A03/MF A01

Dutch research is evaluated in relation to government science and technology policy. Universities and special research institutes are covered. ESA

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N86-31462*# California Univ., San Diego. Center for Astrophysics and Space Sciences.
[ACTIVE PLASMA RELEASE EXPERIMENTS]
1986 81 p
(Grant NAG5-610)
(NASA-CR-176897; NAS 1.26:176897) Avail: NTIS HC A05/MF A01 CSCL 03A

A pulse code modulator (PCM) encoder capable of storing data onboard into the mass memory in the encoder at up to 12 megabits per second was designed and constructed. This telemetry system was programed for two successful flights. All parts of the electronic system functioned perfectly during both previous flights and the detectors performed perfectly. However, in the first flight in Pokerflat, Alaska, an electron arm did not deploy for reasons as yet unkown. The ion arm deployed perfectly and good data was acquired. For individual titles, see N86-31463 through N86-31464.

N86-31463*# California Univ., San Diego. Center for Astrophysics and Space Sciences.
A MAGNETOSPHERIC CRITICAL VELOCITY EXPERIMENT: PARTICLE RESULTS
R. B. Torbert and Patrick T. Newell *In its* Active Plasma Release Experiments 1986 29 p (For primary document see N86-31462 22-89)
Avail: NTIS HC A05/MF A01 CSCL 03A

In March of 1983, a barium injection sounding rocket experiment (The Star of Lima) was conducted to investigate Alfven's critical ionization velocity (CIV) hypothesis in space. Included in the instrumented payload was a particle detection experiment consisting of five retarding potential analyzers. Despite conditions that appeared to be optimal for the critical velocity effect, the particle data, in agreement with optical observations, indicates that a fractional ionization of only approximately .0005 was observed, indicating that the conditions required for the effect to occur are still not well understood. However many of the required phenomena associated with the CIV effect were observed; in particular a superthermal electron population was formed at the expense of ion drift kinetic energy in the presence of intense electrostatic waves near the lower hybrid frequency. The amount of ionization

produced is plausibly consistent with the observed electron flux, but could also be accounted for by residual solar UV at the injection point. It is shown based on the data set that one obvious explanation for the low ionization efficiency, namely that the ionizing superthermal electrons may rapidly escape along field lines, can be ruled out. Author

N86-31464*# Alaska Univ., Fairbanks. Geophysical Inst.
BLACK HOLES, WAVES, AND ENERGIZED PARTICLES FROM HIGH ALTITUDE EXPLOSIVE PLASMA PERTURBATION EXPERIMENTS
E. M. Wescott, H. C. Stenbaek-Nielsen, T. Hallinan, C. Deehr, J. Romick, J. Olson, M. C. Kelley (Cornell Univ., Ithaca, N.Y.), R. Pfaff, R. B. Torbert (California Univ., San Diego.), P. Newell et al *In* California Univ. Active Plasma Release Experiments 1986 52 p (For primary document see N86-31462 22-89)
Avail: NTIS HC A05/MF A01 CSCL 03A

High explosive shaped charge experiments King Crab, Bubble Machine I and II, designed to perturb the ambient plasma and magnetic fields were flown above 460 km on Taurus Tomahawk rockets from Poker Flat in March 1980, 1981, and 1982, respectively. The last two flights were a mother-daughter combination with the instrumentation section remaining attached to the rocket. The first experiment, King Crab, revealed the existence of a barium plasma depleted region or black hole of about 5 km diameter centered on the burst. All electric power to the instruments failed on the liftoff of the 1981 Bubble Machine I, but useful optical data were obtained. The third flight a year later produced useful data from all but the electron detector. Ground based optical and telluric field instrumentation recorded evidence for injection induced waves of about 5 second period. Delay times indicate a slow (175 to 385 km/sec) propagation from the burst point. Concerning locally produced electrostatic instabilities the wave measurements indicate that finite Larmor radius stabilization occurs for the weakly driven low (barium) density situation, but that shorter wavelength waves can occur early in the expansion event when the barium density is higher. Author

N86-31465*# Lowell Observatory, Flagstaff, Ariz.
THE SIZE, SHAPE, DENSITY, AND ALBEDO OF CERES FROM ITS OCCULTATION OF BD+8 DEG 471
R. L. Millis, L. H. Wasserman, O. G. Franz, R. A. Nye, R. C. Oliver, T. J. Kreidl, S. E. Jones, W. Hubbard (Arizona Univ., Tucson.), L. Lebofsky, R. Goff et al 1986 36 p Sponsored in part by F. I. T., Office of Development, and by American Astronautical Society
(Grants NsG-7603; NsG-7500; NsG-7045; NsG-7322; NsG-7114; NsG-7526; NSF 84-14141)
(NASA-CR-177089; NAS 1.26:177089) Avail: NTIS HC A03/MF A01 CSCL 03A

The occultation of BD+8 degrees 471 by Ceres on 13 November 1984 was observed photoelectrically at 13 sites in Mexico, Florida, and the Caribbean. These observations indicate that Ceres is an oblate spheroid having an equatorial radius of 479.6 + or - 2.4 km and a polar radius of 453.4 + or - 4.5 km. The mean density of this minor planet is 2.7 gm/cubic cm + or - 5%, and its visual geometric albedo is 0.070. While the surface appears globally to be in hydrostatic equilibrium, firm evidence of real limb irregularities is seen in the data. Author

N86-31466*# Cornell Univ., Ithaca, N.Y. Dept. of Astronomy.
OBSERVATIONS OF FAR-INFRARED MOLECULAR EMISSION LINES FROM THE ORION MOLECULAR CLOUD Ph.D. Thesis
Paul Joseph Viscuso Aug. 1986 236 p
(Grant NsG-2347)
(NASA-CR-176876; NAS 1.26:176876; CRSR-849) Avail: NTIS HC A11/MF A01 CSCL 03A

The Orion Nebula was the subject of intensive study for over one hundred years. Recently, several far infrared transitions among the low-lying levels of OH were observed toward IRc2. The OH is thought to be abundant, and plays an important role in the chemical evolution of shock and post-shock regions. The OH emission serves as a sensitive probe of the temperature and density for the shock-processed gas. A rigorous treatment of the radiative transfer of these measured transitions was performed using the escape probability formalism. From this analysis, the temperature of the OH-emitting region was determined to be on the order of 40K. This suggests that the gas is part of the post-shock gas that has cooled sufficiently, most likely by way of radiative cooling by CO. Such cooling from shock temperatures of several degrees can be accomplished in 100 years. A molecular hydrogen density of 3 million/cubic cm and an OH column density of 1.0 x 10 to the 17th /sq cm is found. The beam filling factor is determined to be 36%. Author

N86-31467*# Washington Univ., Seattle. Dept. of Astronomy.
A STUDY OF THE DISCREPANT QSO X-RAY LUMINOSITY FUNCTION FROM THE HEAO-2 DATA ARCHIVE Final Technical Report
Bruce Margon 1986 64 p
(Grant NAG8-433)
(NASA-CR-176875; NAS 1.26:176875) Avail: NTIS HC A04/MF A01 CSCL 03A

Sensitive X-ray information for approximately 90 previously uncataloged Quasi-Stellar Objects (QSOs) in the redshift range 1.8 is less than or equal to z which is less than or equal to 3. Even with the longest existing Einstein Observatory X-ray exposures, only 25% of these objects are positively detected in X-rays The data were used to investigate the ensemble X-ray properties of high redshift QSOs, and the QSO population in general. B.G.

N86-31468# Army Engineer Topographic Labs., Fort Belvoir, Va.
ASTROGEODETIC DEFLECTIONS OF THE VERTICAL FROM STARS OBSERVATIONS WITH THE DANJON ASTROLABE, OR SIMILAR INSTRUMENTS
Angel A. Baldini 1985 9 p
(AD-A166886; ETL-R-079) Avail: NTIS HC A02/MF A01 CSCL 03/1

This report is a sequel to the report Basic Formulae for Determining the Computation of the Deflection of the Vertical from Astronomic Star Observations (AD-A154 912). It addresses a new observational method that allows one to compute the astronomic zenith distance of the astrolabe instrument as a function of the time when the stars cross the almucantar of the astrolabe and their right ascension and declination, therefore independent of the astronomic station coordinates. The xi and eta deflection of the vertical components are obtained from an equation that relates the astronomic and geodetic zenith distance. The last is derived for each star as a function of the U. T. 1 time and geodetic latitude and longitude. GRA

N86-30773# Construcciones Aeronauticas S.A., Madrid (Spain). Space and Systems Div.
HIGH-STABILITY TELESCOPE STRUCTURES
G. Galipienso and S. DellAmico *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 119-132 (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-30795# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (West Germany). Neue Technologie.
MANUFACTURING TECHNOLOGY OF GRAZING-INCIDENCE MIRROR CARRIERS MADE OF CARBON FIBER REINFORCED EPOXY MATRIX SYSTEMS
J. Klug *In* ESA Proceedings of a Workshop on Composites Design for Space Applications Feb. 1986 p 311-318 Sponsored by ESA (For primary document see N86-30758 22-18)
Avail: NTIS HC A16/MF A01

N86-31434*# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Electrical Engineering.
CSTAR STAR CATALOGUE DEVELOPMENT
Jo A. Uhde-Lacovara *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 14 p (For primary

document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 03A

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

N86-31469*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
ANTARCTIC METEORITE NEWSLETTER, VOLUME 9, NO. 2
James L. Gooding, ed. Jun. 1986 31 p Sponsored by NSF
(NASA-TM-88774; NAS 1.15P:88774) Avail: NTIS HC A03/MF A01 CSCL 03B

Preliminary description and classifications of meteorites that were completed since publication of the February issue are contained. Most large (greater than 150 g) specimens (regardless of petrologic type) and all pebble sized (less than 150 g) specimens of special petrologic type are represented by separate descriptions. However, specimens of nonspecial petrologic type are listed only as single line entries. For convenience, new specimens are also recast by petrologic type. Each macroscopic description summarizes features that were visible to the eye at the time the meteorite was first examined. Classification is based on microscopic petrography and resonnaissance-level electron-probe microanalysis. The pairing list was updated. B.G.

N86-31470*# Delaware Univ., Newark. Dept. of Physics.
EX-111 THERMAL EMISSION FROM HOT WHITE DWARFS: THE SUGGESTED He ABUNDANCE-TEMPERATURE CORRELATION. EX-112: THE UNIQUE EMISSION LINE WHITE DWARF STAR GD 356 Semiannnual Status Report, 1 Dec. 1985 - 1 Jun. 1986
Harry L. Shipman 27 Aug. 1986 110 p
(Grant NAG8-564)
(NASA-CR-176866; NAS 1.26:176866) Avail: NTIS HC A06/MF A01 CSCL 03B

Progress in the EXOSAT data analysis program is reported. EXOSAT observations for four white dwarfs (WD1031-115, WD0004+330, WD1615-154, and WD0109-264) were obtained. Counting rates were unexpectedly low, indicating that these objects have a substantial amount of x-ray absorbing matter in their photosheres. In addition, soft x-ray pulsations characterized by a 9.25 minute cycle were discovered in the DA white dwarf V471 Tauri. A residual x-ray flux from the K dwarf companion can be seen during the white dwarf eclipse at orbital phase 0.0. Pronounced dips in the soft x-ray light curve occur at orbital phases 0.15, 0.18, and 0.85. The dips may be correlated with the triangular Lagrangian points of the binary orbit. Smaller dips at phases near the eclipse may be associated with cool loops in the K star corona. Data for the white dwarf H1504+65 was also analyzed. This object is particularly unusual in that its photoshere is devoid of hydrogen and helium. Finally, existing data on the white dwarf Sirius B were analyzed to see what constraints from other data can be placed on the properties of this star. Interrelationships between radius, rotational velocity, and effective temperature were derived. M.G.

N86-31471# Instituto de Fisica Teorica, Sao Paulo (Brazil).
QUASAR-GALAXY ASSOCIATIONS WITH DISCORDANT REDSHIFTS AS A TOPOLOGICAL EFFECT, PART 1
H. V. Fagundes 1984 38 p
(DE86-700669; IFT-P-10/84-Pt-1) Avail: NTIS (US Sales Only) HC A03/MF A01

A previously advanced conjecture is developed, that may eventually solve the quasar redshift controversy in a constructive fashion. The claimed galaxy-quasar and other associations with discordant redshifts are recognized as such, but on the level of a little known possibility: that each associated group is the multiple image of a single source, produced by rays emitted along paths of different lengths. This is allowed by the multiply connected topologies of Friedman's closed models of negative spatial curvature. The distances indicated by the cosmological interpretation of the redshifts are now seen as image distances, only one of them being the source's separation from us. In this first part of a two-paper sequence the problem is dealt in the relatively simple context of a hyperbolic 2-dimensional space. This is physically unrealistic, but leads to a few qualitative observational suggestions; and it permits the introduction of the needed mathematical machinery, centered on the tesselations of nyperbolic spaces, in a visualizable way. Thus the reader will be prepared for the less intuitive 3-dimensional research, which is outlined in the last section and will be elaborated in Part II. Some related theoretical topics are discussed along the way. They include reinterpretations of the cosmic isotropy and of the homogeneity principle, and hints of an argumentation for the assumes closure of space. DOE

N86-31472# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
HOMOCLINIC PHENOMENA IN THE GRAVITATIONAL COLLAPSE
J. Koiller, J. R. T. de MelloNeto, and I. D. Soares 1984 15 p Previously announced in AIAA as A85-45751 Prepared in cooperation with Rio de Janeiro Univ., Brazil
(DE86-700671; CBPF-NF-039/84) Avail: (US Sales Only) HC A02/MF A01

A class of Bianchi IX cosmological models is shown to have chaotic gravitational collapse, due to Poincare's homoclinic phenomena. Such models can be programmed so that for any given positive integer N (N=infinity included) the universe undergoes N non-periodic oscillations (each oscillation requiring a long time) before collapsing. For N=infinity the universe undergoes periodic oscillations. DOE

N86-31473# Instituto de Fisica Teorica, Sao Paulo (Brazil).
RELATIVISTIC COSMOLOGIES WITH CLOSED, LOCALLY HOMOGENEOUS SPACE SECTIONS
H. V. Fagundes 1985 12 p Previously announced in AIAA as A85-28135
(DE86-700673; IFT-P-02/85) Avail: NTIS (US Sales Only) HC A02/MF A01

The homogeneous Bianchi and Kantowski-Sachs metrics of relativistic cosmology are investigated through their correspondence with recent geometrical results of Thurston. These allow a partial classification of the topologies for closed, locally homogeneous spaces according to Thurston's eight geometric types. Besides, which of the Bianchi-Kantowski-Sachs metrics can be imposed on closed space sections of cosmological models are learned. This is seen as a progress toward implementation of a postulate of the closure of space for both classical and quantum gravity. DOE

N86-31474# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
UNIFIED MODEL FOR GRAVITY-ELECTRO-WEAK INTERACTIONS
M. Novello and L. M. C. S. Rodrigues 1984 13 p Previously announced in AIAA as A85-43721
(DE86-700688; CBPF-NF-063/84) Avail: NTIS (US Sales Only) HC A02/MF A01

A model is presented in which gravity and electroweak interactions are described in a unique framework. As a consequence very massive particles (of masses approximately 369 and 520.3 GeV) with intermediate W(mu)-W(mu) and W(mu)-Z(mu) interactions are predicted. This new interaction is the short-range counterpart of gravitational interaction. DOE

N86-31475# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
EFFECTIVE POTENTIAL IN N=1, d=4 SUPERGRAVITY COUPLED TO THE VOLKOV-AKULOV FIELD
R. S. Jasinschi and Alexander W. Smith 1984 11 p
(DE86-700634; CBPF-NF-060/84) Avail: NTIS (US Sales Only) HC A02/MF A01

The only-loop effective potential for N=1, d=4 suppergravity theory coupled to the Volkov-Akulov field is calculated. Then it is

shown that after an adjustment of some parameters the local supersymmetry is dynamically broken and as a consequence the gravitino acquires mass. DOE

N86-31476# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
MAGNETIC FIELDS OF COSMIC BODIES
B. V. Vasilev 1985 6 p In RUSSIAN Submitted for publication (DE86-701119; JINR-R-17-85-255) Avail: (US Sales Only) NTIS HC A02/MF A01

Magnetic fields generation for rotating cosmic bodies due to the gravitationally induced electrical polarization is discussed. DOE

N86-31477# Los Alamos National Lab., N. Mex.
NOVA OUTBURST MODELING AND ITS APPLICATION TO THE RECURRENT NOVA PHENOMENON
W. M. Sparks, S. Starrfield, and J. Truran Dec. 1985 13 p Presented at the Conference on RS Ophiuchi and the Recurrent Nova Phenomenon, Manchester, England, 1 Dec. 1985 Prepared in cooperation with Illinois Univ., Urbana
(Contract W-7405-eng-36)
(DE86-008715; LA-UR-86-806; CONF-851272-1) Avail: NTIS HC A02/MF A01

The thermonuclear runaway (TNR) theory for the cause of the common novae is reviewed. Numerical simulations of this theory were performed using an implicit hydrodynamic Lagrangian computer code. Relevant physical phenomena are explained with the simpler envelope in place calculations. Next the models that include accretion are discussed. The calculations agree very well with observations of common novae. The observational differences between common novae and recurrent novae are examined. We propose input parameters to the TNR model which can give the outburst characteristics of RS Ophiuchi and discuss the implications. This review is concluded with a brief discussion of two current topics in novae research: shear mixing on the white dwarf and Neon novae. DOE

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design see *18 Spacecraft Design Testing, and Performance.* For space stations see *15 Launch Vehicles and Space Vehicles.*

N86-31478*# State Univ. of New York, Stony Brook. Lab. for Planetary Atmospheres Research.
STUDIES OF THE AURORALLY-INDUCED ULTRAVIOLET EMISSIONS ON THE NIGHTSIDE OF VENUS Report, 1 Jan. 1985 - 31 Mar. 1986
J. L. Fox 31 Mar. 1986 23 p
(Grant NAG2-329)
(NASA-CR-177004; NAS 1.26:177004) Avail: NTIS HC A02/MF A01 CSCL 03B

The effect of a monoenergetic flux of electrons on a model atmosphere of the nightside thermosphere of Venus was examined. The neutral model chosen is that of Hedin for high solar activity and I65 degrees solar zenith angle. The model is based on measurements made by the Pioneer Venus Orbiter Neutral Mass Spectrometer. Four species were included in the calculation: CO2, O, CO, and N2. The numerical method that was chosen for energy deposition of the primary electrons is the continuous slowing down approximation. The secondary electron distribution was computed using the empirically determined shape of the differential cross section. B.G.

N86-31479*# Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.
STUDIES OF RADIATIVE TRANSFER IN PLANETARY ATMOSPHERES Semiannual Status Report, 1 Dec. 1985 - 31 May 1986
William M. Irvine and F. Peter Schloerb 31 Jul. 1986 13 p
(Grant NGL-22-010-023)
(NASA-CR-176898; NAS 1.26:176898) Avail: NTIS HC A02/MF A01 CSCL 03B

A set of high signal-to-noise spectra of the 18 cm OH emission from the comet P/Halley was obtained. During the course of the Halley OH campaign, high signal-to-noise spectra were also obtained on the comets P/Giacobini-Zinner, C/Thiele, and C/Hartley-Good. The HCN observations of Comet Halley were performed during a total of 56 individual observing sessions between 18 November 1985 and 11 May 1986. These observations represent the largest monitoring program of HCN emission from any comet, and moreover, represent the first time that a cometary parent molecule was so extensively observed. In addition to offering a direct means to monitor the production of a parent molecule from the nucleus, these data also provide fundamental information about the kinematics of parent molecules in the coma. Finally, in addition to monitoring HCN from the comet, attempts were also made to detect other molecues via millimeter-wave spectroscopy. Future plans are descussed. B.G.

N86-31480# Los Alamos National Lab., N. Mex.
EXISTENCE OF UNDISCOVERED URANIAN SATELLITES
D. C. Boice Apr. 1986 9 p
(Contract W-7405-eng-36)
(DE86-008161; LA-10669-MS) Avail: NTIS HC A02/MF A01

Structure in the Uranian ring system as observed in recent occultations may contain indirect evidence for the existence of undiscovered satellites. Using the Alfven and Arrhenius (1975, 1976) scenario for the formation of planetary systems, the orbital radii of up to nine hypothetical satellites interior to Miranda are computed. These calculations should provide interesting comparisons when the results from the Voyager 2 encounter with Uranus are made public. DOE

N86-31121*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RIFTING ON VENUS: IMPLICATIONS FOR LITHOSPHERIC STRUCTURE
W. B. Banerdt and M. P. Golombek *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 2 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

N86-31130*# Arizona Univ., Tucson. Lunar and Planetary Lab.
TECTONIC DETERMINATIONS OF LITHOSPHERIC THICKNESS ON GANYMEDE AND CALLISTO
Steven K. Croft *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 34-37 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

N86-31134*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
LITHOSPHERIC STRENGTH OF GANYMEDE: CLUES TO EARLY THERMAL PROFILES FROM EXTENSIONAL TECTONIC FEATURES
M. P. Golombek and W. B. Banerdt *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 45-49 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

N86-31142*# Arizona State Univ., Tempe. Dept. of Geology.
HOT-SPOT TECTONICS ON IO
Alfred S. McEwen *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 76-80 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

N86-31146*# Arizona State Univ., Tempe. Dept. of Geology.
EXTENSIONAL TECTONICS OF THE SATURNIAN SATELLITES
Jeffrey M. Moore *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 91-92 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

N86-31161*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences
RIFT SYSTEMS ON VENUS: AN ASSESSMENT OF MECHANICAL AND THERMAL MODELS
Sean C. Solomon and James W. Head (Brown Univ., Providence, R. I.) *In* Lunar and Planetary Inst. Papers Presented to the Conference on Heat and Detachment in Crustal Extension on Continents and Planets 1985 p 138 - 141 (For primary document see N86-31119 22-46)
Avail: NTIS HC A08/MF A01 CSCL 08G

N86-31415*# Oregon State Univ., Corvallis.
CHRONOLOGY AND ISOTOPIC GEOCHEMISTRY OF APOLLO 14 BASALTS AND SKAERGARD GABBRO, EASTERN GREENLAND Final Report
E. Julius Dasch *In* NASA. Johnson Space Center NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1985 Jul. 1986 6 p (For primary document see N86-31409 22-80)
Avail: NTIS HC A99/MF E03 CSCL 03B

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N86-31481# Los Alamos National Lab., N. Mex.
SUPERPOSED EPOCH ANALYSIS OF MAGNETOSPHERIC SUBSTORMS USING SOLAR WIND, AURORAL ZONE AND GEOSTATIONARY ORBIT DATA SETS
L. F. Bargatze, D. N. Baker, and R. L. McPherron 1985 25 p Presented at the Chapman Conference on Magnetotail Physics, Laurel, Md., 28 Oct. 1985 Prepared in cooperation with California Univ., Los Angeles
(Contract W-7405-eng-36)
(DE86-006036; LA-UR-86-344; CONF-8510254-2) Avail: NTIS HC A02/MF A01

A primary goal in solar wind-magnetosphere studies is to understand how and what role the solar wind plays in controlling the temporal sequence of events during substorms at many widely separated regions within the magnetosphere. Here, the average, correlated behavior of definitve solar wind, auroral zone, and geostationary orbit parameters during isolated substorms is examined. High time resolution (1 min) measurements of two solar wind quantities: B/sub z/ and VB/sub s/, two auroral electrojet indices: AE and AI, and three paramenters which define the energetic (30 to 300keV) electron distribution at geostationary orbit from 13 events are analyzed by using the superposed epoch technique. The zero epoch time used to organize the analyses were defined by the time of energetic electron injection at geostationary orbit. The average variations of the auroral zone and geostationary orbit parameters in relation to the solar wind are discussed in context of the three phase (growth, expansion, and recovery) model of substorms. Notably, we find an approximate 6 minute time lag of expansion phase onset at geostationary orbit relative to time of expansion phase onset in the auroral zone. A possible explanation for this time lag is briefly discussed. DOE

N86-31482# National Center for Atmospheric Research, Boulder, Colo.
LARGE-SCALE STRUCTURE AND DYNAMICS OF SOLAR ACTIVE REGIONS OBSERVED IN THE FAR ULTRAVIOLET Ph.D. Thesis - Colorado Univ.
Andrew James Klimchuk 1986 219 p
(Grant NSF ATM-82-17015)
(PB86-188802; NCAR/CT-96) Avail: NTIS HC A10/MF A01 CSCL 03B

High resolution Dopplergrams in CIV (1548) are examined for the purpose of understanding the large-scale dynamics of solar active regions and the closely related problem of magnetic structure. The Dopplergrams are compared with photospheric magnetograms and H(alpha) filtergrams in order to determine the relationship of the flows to the overall magnetic field topology. These observations sample three different heights in the atmosphere and can potentially be used to map the field from the photosphere up through the transition region. Vector properties of the flow and field are inferred from center to limb variations in the measured Doppler shift and longitudinal field component. GRA

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer Earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N86-31483*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NINETEENTH INTERNATIONAL COSMIC RAY CONFERENCE. CONFERENCE PAPERS: INVITED RAPPORTEUR, HIGHLIGHT, MISCELLANEOUS, VOLUME 9
Frank C. Jones, comp. Feb. 1986 555 p Conference held in La Jolla, Calif., 11-23 Aug. 1985
(NASA-CP-2376-Vol-9; NAS 1.55:2376-Vol-9) Avail: NTIS HC as boxed set only $200/MF A01 per volume or E99 per entire set CSCL 03B

Invited talks, rapporteur talks, and highlight talks are included. Topics of the invited and highlight talks include astrophysical jets, gamma-ray line astronomy, cosmic rays and gamma rays in astrophysics, the early universe, elementary particle physics, solar flares and acceleration of energetic particles, cosmogenic nuclei, extragalactic astronomy, composition of solar flare particles, very high energy gamma ray sources, gamma-ray bursts, shock acceleration in the solar wind, cosmic rays in deep underground detectors, spectrum of cosmic rays at 10 to the 19th power eV, and nucleus-nucleus interactions. For individual titles, see N86-31484 through N86-31521.

N86-31484*# Institute of Astronomy, Cambridge (England).
COSMIC JETS
Martin J. Rees *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 17 p (For primary document see N86-31483 22-93)
Avail: NTIS HC as boxed set only $200/MF A01 per volume or E99 per entire set CSCL 03B

The evidence that active galactic nuclei produce collimated plasma jets is summarised. The strongest radio galaxies are probably energised by relativistic plasma jets generated by spinning black holes interacting with magnetic fields attached to infalling matter. Such objects can produce e(+)-e(-) plasma, and may be relevant to the acceleration of the highest-energy cosmic ray primaries. Small-scale counterparts of the jet phenomenon within our own galaxy are briefly reviewed. Author

N86-31485*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAMMA-RAY LINE ASTROPHYSICS
Richard E. Lingenfelter (California Univ., La Jolla.) and Reuven Ramaty *In its* Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 23 p (For primary document see N86-31483 22-93)

Avail: NTIS HC as boxed set only $200/MF A01 per volume or E99 per entire set CSCL 03B

Recent observations of gamma-ray line emission from solar flares, gamma-ray bursts, the galactic center, the interstellar medium and the jets of SS433 are reviewed. The implications of these observations on high energy processes in these sources are discussed. Author

N86-31486*# National Aeronautics and Space Administration, Washington, D.C.

CONSTRAINTS ON GALAXY FORMATION THEORIES

Alexander S. Szalay *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 11 p Prepared in cooperation with Eotvos Lorand Univ., Budapest, Hungary (For primary document see N86-31483 22-93)

Avail: NTIS HC as boxed set only $200/MF A01 per volume or E99 per entire set CSCL 03B

The present theories of galaxy formation are reviewed. The relation between peculiar velocities, temperature fluctuations of the microwave background and the correlation function of galaxies point to the possibility that galaxies do not form uniformly everywhere. The velocity data provide strong constraints on the theories even in the case when light does not follow mass of the universe. Author

N86-31487*# Oxford Univ. (England). Dept. of Nuclear Physics.

ELEMENTARY PARTICLE PHYSICS

D. H. Perkins *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 18 p (For primary document see N86-31483 22-93)

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Elementary particle physics is discussed. Status of the Standard Model of electroweak and strong interactions; phenomena beyond the Standard Model; new accelerator projects; and possible contributions from non-accelerator experiments are examined. Author

N86-31488*# Centre National de la Recherche Scientifique, Orsay (France).

COSMOGENIC NUCLEI

G. M. Raisbeck *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 13 p (For primary document see N86-31483 22-93)

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Cosmogenic nuclei, nuclides formed by nuclear interactions of galactic and solar cosmic rays with extraterrestrial or terrestrial matter are discussed. Long lived radioactive cosmogenic isotopes are focused upon. Their uses in dating, as tracers of the interactions of cosmic rays with matter, and in obtaining information on the variation of primary cosmic ray flux in the past are discussed. R.J.F.

N86-31489*# California Univ., San Diego. Center for Astrophysics and Space Sciences.

EXTRAGALACTIC ASTRONOMY

E. Margaret Burbidge *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 6 p (For primary document see N86-31483 22-93)

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Components of the active extragalactic universe are examined to discover what extragalactic objects exhibit physical processes of the same kind as those thought to be important within the galaxy. Radio galaxies; quasars; bulk ejection from galactic objects such as novae supernovae, and other galactic nuclei; the red shifts of quasars; and the possibility of non-cosmological red shifts are among the topics discussed. It is concluded that the highest energy cosmic rays may have an extragalactic or extragalactic origin. R.J.F.

N86-31490*# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.

GAMMA RAY ASTRONOMY FROM SATELLITES AND BALLOONS

V. Schoenfelder *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 17 p (For primary document see N86-31483 22-93)

Avail: NTIS HC as boxed set only $200/MF A01 per volume or E99 per entire set CSCL 03B

A survey is given of gamma ray astronomy topics presented at the Cosmic Ray Conference. The major conclusions at the Cosmic Ray Conference in the field of gamma ray astronomy are given. (1) MeV-emission of gamma-ray bursts is a common feature. Variations in duration and energy spectra from burst to burst may explain the discrepancy between the measured log N - log S dependence and the observed isotropy of bursts. (2) The gamma-ray line at 1.809 MeV from Al(26) is the first detected line from a radioactive nucleosynthesis product. In order to understand its origin it will be necessary to measure its longitude distribution in the Milky Way. (3) The indications of a gamma-ray excess found from the direction of Loop I is consistent with the picture that the bulk of cosmic rays below 100 GeV is produced in galactic supernova remnants. (4) The interpretation of the large scale distribution of gamma rays in the Milky Way is controversial. At present an extragalactic origin of the cosmic ray nuclei in the GeV-range cannot be excluded from the gamma ray data. (5) The detection of MeV-emission from Cen A is a promising step towards the interesting field of extragalactic gamma ray astronomy. Author

N86-31491*# Leeds Univ. (England). Dept. of Physics.

COSMIC GAMMA-RAYS AND COSMIC NUCLEI ABOVE 1 TeV

A. A. Watson *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 30 p (For primary document see N86-31483 22-93)

Avail: NTIS HC as boxed set only $200/MF A01 per volume or E99 per entire set CSCL 03B

Work on cosmic gamma rays and cosmic nuclei above I TeV is described and evaluated. The prospect that gamma ray astronomy above I TeV will give new insights into high energy cosmic ray origin within our galaxy is particularly bright. Author

N86-31492*# Commissariat a l'Energie Atomique, Saclay (France). Service d'Astrophysique.

GALACTIC COSMIC RAY COMPOSITION

Jean-Paul Meyer *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 73 p (For primary document see N86-31483 22-93)

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An assessment is given of the galactic cosmic ray source (GCRS) elemental composition and its correlation with first ionization potential. The isotopic composition of heavy nuclei; spallation cross sections; energy spectra of primary nuclei; electrons; positrons; local galactic reference abundances; comparison of solar energetic particles and solar coronal compositions; the hydrogen; lead; nitrogen; helium; and germanium deficiency problems; and the excess of elements are among the topics covered. R.J.F.

N86-31493*# Academy of Sciences (USSR), Moscow. Ionosphere and Radio Wave Propagation Dept.

COSMIC RAY SOURCES, ACCELERATION AND PROPAGATION

V. S. Ptuskin *In* NASA. Goddard Space Flight Center Nineteenth

International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 21 p (For primary document see N86-31483 22-93)
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A review is given of selected papers on the theory of cosmic ray (CR) propagation and acceleration. The high isotropy and a comparatively large age of galactic CR are explained by the effective interaction of relativistic particles with random and regular electromagnetic fields in interstellar medium. The kinetic theory of CR propagation in the Galaxy is formulated similarly to the elaborate theory of CR propagation in heliosphere. The substantial difference between these theories is explained by the necessity to take into account in some cases the collective effects due to a rather high density of relativisitc particles. In particular, the kinetic CR stream instability and the hydrodynamic Parker instability is studied. The interaction of relativistic particles with an ensemble of given weak random magnetic fields is calculated by perturbation theory. The theory of CR transfer is considered to be basically completed for this case. The main problem consists in poor information about the structure of the regular and the random galactic magnetic fields. An account is given of CR transfer in a turbulent medium. Author

N86-31494*# California Univ., Berkeley. Space Sciences Lab.
PARTICLE ACCELERATION BY THE SUN
R. P. Lin *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 13 p (For primary document see N86-31483 22-93)
(Grant NAG5-376)
Avail: NTIS HC as boxed set only $200/MF A01 per volume or E99 per entire set CSCL 03B

A review is given of the analysis of new observations of energetic particles and energetic secondary emissions obtained over the solar maxium (approx. 1980) by the Solar Maximum mission, Hinotori, the international Sun-Earth Explorer, Helios, Explorer satellites, and Voyager spacecraft. Solar energetic particle events observed in space, He(3)- rich events, solar gamma rays and neutrons, and solar neutrinos are discussed. R.J.F.

N86-31495*# Malaya Univ., Kuala-Lumpur. Dept. of Mathematics
CORONAL AND INTERPLANETARY PROPAGATION, INTERPLANETARY ACCELERATION, COSMIC-RAY OBSERVATIONS BY DEEP SPACE NETWORK AND ANOMALOUS COMPONENT
C. K. Ng *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 13 p (For primary document see N86-31483 22-93)
Avail: NTIS HC as boxed set only $200/MF A01 per volume or E99 per entire set CSCL 03B

The purpose is to provide an overview of the contributions presented in sessions SH3, SH1.5, SH4.6 and SH4.7 of the 19th International Cosmic Ray Conference. These contributed papers indicate that steady progress continues to be made in both the observational and the theoretical aspects of the transport and acceleration of energetic charged particles in the heliosphere. Studies of solar and interplanetary particles have placed emphasis on particle directional distributions in relation to pitch-angle scattering and magnetic focusing, on the rigidity and spatial dependence of the mean free path, and on new propagation regimes in the inner and outer heliosphere. Coronal propagation appears in need of correlative multi-spacecraft studies in association with detailed observation of the flare process and coronal magnetic structures. Interplanetary acceleration has now gone into a consolidation phase, with theories being worked out in detail and checked against observation. Author

N86-31496*# Central Research Inst. for Physics, Budapest (Hungary).
MODULATION AND ANISOTROPY OF GALACTIC COSMIC RAYS IN THE HELIOSPHERE
J. Kota *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers; Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 25 p Prepared in cooperation with Arizona Univ., Tucson (For primary document see N86-31483 22-93)
(Grants NSF ATM-220-18; NSF INT-84-00591)
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Modulation model are discussed with more time spent on two current ideas: episodic modulation and drift models. The various types of anisotropies are addressed. Finally, other time variations and correlation studies are reviewed. Author

N86-31497*# Bern Univ. (Switzerland). Physikalisches Inst.
FORBUSH DECREASES GEOMAGNETIC AND ATMOSPHERIC EFFECTS COSMOGENIC NUCLIDES
Erwin O. Flueckiger *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 21 p (For primary document see N86-31483 22-93)
Avail: NTIS HC as boxed set only $200/MF A01 per volume or E99 per entire set CSCL 03B

An overview and synthesis is given of recent developments that have occurred in the areas of Forbush decreases, geomagnetic and atmospheric effects, and cosmogenic nuclides. Experimental evidence has been found for substantial differences in the effects of the various types of interplanetary perturbations on cosmic rays, and for a dependence of these effects on the three-dimensional configuration of the interplanetary medium. In order to fully understand and to be able to simulate the solar cosmic ray particle access to the polar regions of the earth we need accurate models of the magnetospheric magnetic field. These models must include all major magnetospheric current systems (in particular the field aligned currents), and they should represent magnetically quiet time periods as well as different levels of geomagnetic activity. In the evolution of magnetospheric magnetic field models, cosmic ray and magnetospheric physicists should work closely together since cosmic ray measurements are a powerful additional tool in the study of the perturbed magnetosphere. In the field of cosmogenic nuclides, finally, exciting new results and developments follow in rapid succession. Thanks to new techniques and new isotopes the analysis of cosmic ray history has entered into a new dimension. Author

N86-31498*# Michigan Univ., Ann Arbor. Dept. of Physics.
HIGH ENERGY INTERACTIONS OF COSMIC RAY PARTICLES
Lawrence W. Jones *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 14 p (For primary document see N86-31483 22-93)
Avail: NTIS HC as boxed set only $200/MF A01 per volume or E99 per entire set CSCL 03B

The highlights of seven sessions of the Conference dealing with high energy interactions of cosmic rays are discussed. High energy cross section measurements; particle production-models of experiments; nuclei and nuclear matter; nucleus-nucleus collision; searches for magnetic monopoles; and studies of nucleon decay are covered. Author

N86-31499*# Yokohama National Univ. (Japan).
EMULSION CHAMBER OBSERVATIONS AND INTERPRETATION (HE 3)
M. Shibata *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 19 p (For primary document see N86-31483 22-93)
Avail: NTIS HC as boxed set only $200/MF A01 per volume or E99 per entire set CSCL 03B

Experimental results from Emulsion Chamber (EC) experiments at mountain altitudes or at higher levels using flying carriers are examined. The physical interest in this field is concentrated on the strong interaction at the very high energy region exceeding the accelerator energy, also on the primary cosmic ray intensity and its chemical composition. Those experi-

ments which observed cosmic ray secondaries gave information on high energy interaction characteristics through the analyses of secondary spectra, gamma-hadron families and C-jets (direct observation of the particle production occuring at the carbon target). Problems of scaling violation in fragmentation region, interaction cross section, transverse momentum of produced secondaries, and some peculiar features of exotic events are discussed. B.G.

N86-31500*# Adelaide Univ. (Australia). Dept. of Physics.
EXTENSIVE AIR SHOWERS (HE-4)
R. W. Clay *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 26 p (For primary document see N86-31483 22-93)
Avail: NTIS HC as boxed set only $200/MF A01 per volume or E99 per entire set CSCL 03B

Ultra high energy (UHE) gamma ray astronomy is an exciting area which has added a new sense of purpose to ground based array work. There is much to be done before UHE gamma ray showers can be understood properly and it is important to remain conservative with claims while the properties of such showers are still not clear. The muon content is only one of the properties that needs to be clarified. It remains to be seen how well progress occurs on the second order problem of detailed interaction parameters once the gross features are clarified. The shower disk thickness has become an area of intense study with interest in Linsley's technique for measuremnts of giant showers and in the study of structure near the core for improving fast timing and studying delayed subshowers. Perhaps the most significant area of promise for the future is individual shower develpments with Cerenkov and, particularly, air fluorescence techniques. The importance and potential of having relatively complete information on a complete set of individual showers can hardly be overestimated. A complete understanding of the observation process is needed to determine whether or not the recorded data set is complete at a given energy, apparent core distance, and zenith angle. B.G.

N86-31501*# Wisconsin Univ., Madison. Dept. of Physics.
MUONS AND NEUTRINOS
T. Stanev *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 16 p Prepared in cooperation with Delaware Univ., Newark (For primary document see N86-31483 22-93)
(Contract DE-AC02-76ER-00881)
Avail: NTIS HC as boxed set only $200/MF A01 per volume or E99 per entire set CSCL 03B

The first generation of large and precise detectors, some initially dedicated to search for nucleon decay has accumulated significant statistics on neutrinos and high-energy muons. A second generation of even better and bigger detectors are already in operation or in advanced construction stage. The present set of experimental data on muon groups and neutrinos is qualitatively better than several years ago and the expectations for the following years are high. Composition studies with underground muon groups, neutrino detection, and expected extraterrestrial neutrino fluxes are discussed. B.G.

N86-31502*# Durham Univ. (England). Dept. of Physics.
GROUND-BASED VERY HIGH ENERGY GAMMA RAY ASTRONOMY: OBSERVATIONAL HIGHLIGHTS
K. E. Turver *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 8 p (For primary document see N86-31483 22-93)
Avail: NTIS HC as boxed set only $200/MF A01 per volume or E99 per entire set CSCL 03B

It is now more than 20 years since the first ground based gamma ray experiments involving atmospheric Cerenkov radiation were undertaken. The present highlights in observational ground-based very high energy (VHE) gamma ray astronomy and the optimism about an interesting future for the field follow progress in these areas: (1) the detection at increased levels of confidence of an enlarged number of sources so that at present claims were made for the detection, at the 4 to 5 sd level of significance, of 8 point sources; (2) the replication of the claimed detections with, for the first time, confirmation of the nature and detail of the emission; and (3) the extension of gamma ray astronomy to the ultra high energy (UHE) domain. The pattern, if any, to emerge from the list of sources claimed so far is that X-ray binary sources appear to be copious emitters of gamma rays over at least 4 decades of energy. These X-ray sources which behave as VHE and UHE gamma ray emitters are examined. Author

N86-31503*# Leeds Univ. (England). Dept. of Physics.
WHY IS CYGNUS X-3 (WITH RELATED SOURCES) A HIGHLIGHT OF COSMIC-RAY ASTROPHYSICS?
A. M. Hillas *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 8 p (For primary document see N86-31483 22-93)
Avail: NTIS HC as boxed set only $200/MF A01 per volume or E99 per entire set CSCL 03B

Cygnus X-3 and some apparently related systems have sprung into remarkable prominence. The reasons for this great interest are summarized. Some recent developments in the picture of these sources are also outlined. B.G.

N86-31504*# Academy of Sciences (USSR), Leningrad. Physical-Technical Inst.
OBSERVATIONAL PROPERTIES OF COSMIC GAMMA-RAY BURSTS
E. P. Mazets *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 16 p (For primary document see N86-31483 22-93)
Avail: NTIS HC as boxed set only $200/MF A01 per volume or E99 per entire set CSCL 03B

A brief overview of the major observational results obtained in gamma-ray burst studies is presented. Also discussed is to what extent the thermonuclear model, which appears at present to be the most plausible, can account for the observed properties of the bursts. The investigation of gamma-ray bursts should cover observations of the time histories of events, energy spectra, and their variablility, source localization, and inspection of the localization regions during the active and quiescent phases of the source in other wavelengths, as well as, evaluation of the statistical distributions of the data obtained. Author

N86-31505*# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
OBSERVATIONS OF SHOCK ACCELERATION PROCESSES IN THE SOLAR WIND
M. Scholer *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Misacellaneous, Volume 9 Feb. 1986 10 p (For primary document see N86-31483 22-93)
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Substantial evidence was accumulated over more than two decades that ion acceleration occurs at all collisionless shocks sampled directly in the solar system. The various shock waves in the heliosphere and the associated energetic particle phenomena are shown schematically. Three shocks have attracted considerable attention in recent years: corotating shocks due to the interaction of fast and slow solar wind streams during solar minimum, travelling interplanetary shocks due to coronal mass ejections, and planetary bow shocks. The signatures of these shocks and of their energetic particles are briefly reviewed. The most prominent theoretical models for shock acceleration are also reviewed. Recent observations at the earth's bow shock and at quasi-parallel interplanetary shocks are discussed in detail. Author

N86-31506*# Academy of Sciences (USSR), Moscow.
IS THE SIGNAL FROM CYG X-3, AS RECORDED IN SOME UNDERGROUND EXPERIMENTS, REAL?
A. E. Chudakov *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 4 p (For primary document see N86-31483 22-93)
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Most of the excitement concerning the underground detection of signals from Cyg X-3 comes not from astrophysical grounds, but from the contradiction with surface experimental data. Believing in the Cyg X-3 signal underground and also that the main processes of muon production are well knownm the conclusion was drawn that the signal in EAS Cherenkov or counter experiments could be remarkably high, which is not the case. Possible solutions to this discrepancy are discussed. B.G.

N86-31507*# Argonne National Lab., Ill. High Energy Physics Div.
EVIDENCE FROM THE SOUDAN 1 EXPERIMENT FOR UNDERGROUND MUONS ASSOCIATED WITH CYGNUS X-3
D. S. E. Ayres *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 10 p (For primary document see N86-31483 22-93)
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The Soudan 1 experiment has yielded evidence for an average underground muon flux of approximately 7 x 10 to the minus 11th power/sq cm/s which points back to the X-ray binary Cygnus X-3, and which exhibits the 4.8 h periodicity observed for other radiation from this source. Underground muon events which seem to be associated with Cygnus X-3 also show evidence for longer time variability of the flux. Such underground muons cannot be explained by any conventional models of the propagation and interaction of cosmic rays. Author

N86-31508*# Consiglio Nazionale delle Ricerche, Turin (Italy). Istituto di Cosmogeofisica.
OBSERVATION OF MUONS FROM CYGNUS X-3 IN THE NUSEX EXPERIMENT
B. DEttorre Piazzoli *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 10 p (For primary document see N86-31483 22-93)
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Ground based observations by means of Cerenkov light detectors and air shower arrays have established that Cyngus X-3 is a powerful source of high energy particles. The detection of a 10 to the 15th power eV signal was first reported by the Kiel experiment. Air showers with large age parameter were accepted in order to select those generated by primary gamma rays. At variance with the expectation, the muon density associated with these events was found to be surprisingly high. This puzzling result stimulated a temporal analysis of the muons recorded in Nucleon Stability Experiment (NUSEX) coming from the region around the source. A positive signal was found suggesting the presentation of this result. The analysis of the data recorded during the 2.4 years of effective working time is presented with a fine tuning of the period and the energy spectrum of the muons from the Cygnus X-3 direction derived assuming consistency between NUSEX and SOUDAN results. Author

N86-31509*# Commissariat a l'Energie Atomique, Saclay (France). Dept. de Physique des Particules Elementaires.
SEARCH FOR A PERIODIC SIGNAL FROM CYGNUS X-3 USING-MUONS OBSERVED UNDERGROUND IN THE FREJUS DETECTOR (4800 MWE)
P. Bareyre, R. Barloutaud, K. H. Becker (Gesamthochschule, Wuppertal (West Germany).), L. Behr (Ecole Polytechnique, Palaiseau (France).), C. Berger (Technische Hochschule, Aachen (West Germany).), R. W. Bland (Ecole Polytechnique, Palaiseau (France).), G. Chardin, H. J. Daum (Gesamthochschule, Wuppertal (West Germany).), B. Degrange (Ecole Polytechnique, Palaiseau (France).), S. Demski (Gesamthochschule, Wuppertal (West Germany).) et al *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 9 p (For primary document see N86-31483 22-93)
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Periodic signals from Cygnus X-3 in the ultra high energy range were recently reported by air shower arrays and attributed to gamma rays. Although gamma rays are expected to produce muon-poor showers, the preceding observations have stimulated similar studies based on underground muons. Two groups have claimed a significant underground signal coming from Cygnus X-3. The results are, however, extremely difficult to explain in the present framework of particle physics, and clearly need confirmation. The preliminary results obtained from the Frejus underground detector during its first 16 months of operation (March 1984 to June 1985) are presented. Author

N86-31510*# New Mexico Univ., Albuquerque. Dept. of Physics and Astronomy.
THE COSMIC RAY SPECTRUM ABOVE 10(19) EV AT VOLCANO RANCH AND HAVERAH PARK
John Linsley *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 12 p (For primary document see N86-31483 22-93)
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The cosmic ray energy per particle spectrum above 10 to the 19th power eV is measured the same way that energy spectra are measured at much lower energies, by counting all of the particles in a specified energy range that are incident per unit time with trajectories within specified geometrical limits. Difficulties with background or poorly known detection efficiency are markedly less than in some other cosmic ray measurements. The fraction of primary energy given to muons, neutrinos, and slow hadrons is less than 10% in this region, so the primary energy equals the track length integral of the secondary electrons with only a small correction for the energy given to other kinds of particles. Results from Volcano Ranch and Haverah Park are compared with results from the Yakutsk experiment. Author

N86-31511*# Moscow State Univ. (USSR). Inst. of Nuclear Physics.
MEASURING THE ENERGY SPECTRUM OF PRIMARY COSMIC RAYS WITH THE YAKUTSK EAS ARRAY
G, B. Khristiansen *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 11 p (For primary document see N86-31483 22-93)
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The Yakutsk Extensive Air Showers (EAS) array was designed for detecting the showers generated by the 10 to the 47th power to 10 to the 20th power eV primary cosmic rays and consists of numerous electron, muon, and Cerenkov light detectors arranged on a 20 sq km area terrain. The array is featured by the feasibility to detect the EAS-produced Cerenkov light, hence, as will be shown, to find the mean energy of the primary particles generating an ensemble of EAS of given size. Date collected is discussed. Author

N86-31512*# Sydney Univ. (Australia). School of Physics.
THE COSMIC RAY SPECTRUM ABOVE 10(17) eV
M. M. Winn, J. Ulrichs, L. Horton, C. B. A. McCusker, and L. S. Peak *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 9 p Sponsored in part by AFOSR (For primary document see

N86-31483 22-93
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The final analysis of the data obtained by the Sydney University Giant Airshower Recorder (SUGAR) is presented. The data has been reanalysed to take into account the effects of afterpulsing in the photomultiplier tubes. Event data was used to produce a spectrum of equivalent vertical muon number and from this a model dependent primary energy spectrum was obtained. These spectra show good evidence for the Ankle: a flattening at 10(19) eV. There is no sign of the cut-off which would be expected from the effects of the universal black body radiation. Author

N86-31513*# Institute of Nuclear Physics, Krakow (Poland).
HIGH ENERGY NUCLEUS-NUCLEUS COLLISIONS
Barbara Wosiek *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 10 p (For primary document see N86-31483 22-93)
(Grant NSF PHY-83-04003)
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Experimental results on high energy nucleus-nucleus interactions are presented. The data are discussed within the framework of standard super-position models and from the point-of-view of the possible formation of new states of matter in heavy ion collisions. Author

N86-31514*# Leeds Univ. (England). Dept. of Physics.
STUDIES OF AIR SHOWERS PRODUCED BY PRIMARIES > 10(16) eV USING A COMBINED SCINTILLATION AND WATER-CERENKOV ARRAY
G. Brooke, J. C. Perrett, and A. A. Watson *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 4 p Sponsored in part by Science and Engineering Research Council (For primary document see N86-31483 22-93)
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An array of 8 x 1.0 sq m plastic scintillation counters and 13 water-Cerenkov detectors (1 to 13.5 sq m) were operated at the center of the Haverah Park array to study some features of air showers produced by 10(16) eV primaries. Measurements of the scintillator lateral distribution function, the water-Cerenkov lateral distribution function, and of the distance dependence of the Cerenkov/scintillator ratio are described. Author

N86-31515*# Pennsylvania Univ., Philadelphia. Depts. of Physics and Astronomy.
THE HOMESTAKE SURFACE-UNDERGROUND SCINTILLATORS: INITIAL RESULTS
M. L. Cherry, S. Corbato, T. Daily, E. J. Fenyves (Texas Univ., Dallas.), D. Kieda, K. Lande, and C. K. Lee *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 4 p (For primary document see N86-31483 22-93)
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The first 70 tons of the 140-ton Large Area Scintillation Detector (LASD) have been operating since Jan. 1985 at a depth of 4850 ft. (4200 m.w.e.) in the Homestake Gold Mine, Lead, S.D. A total of 4 x 10(4) high-energy muons (E sub mu is approx. 2.7 TeV at the surface) have been detected. The remainder of the detector is scheduled to be in operation by the Fall of 1985. In addition, a surface air shower array is under construction. The first 27 surface counters, spaced out over an area of 270' x 500', began running in June, 1985. The LASD performance, the potential of the combined shower array and underground muon experiment for detecting point sources, and the initial results of a search for periodic emission from Cygnus X-3 are discussed. M.G.

N86-31516*# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
LEAD, PLATINUM AND OTHER HEAVY ELEMENTS IN THE PRIMARY COSMIC RADIATION: HEAO-3 RESULTS
C. J. Waddington, W. R. Binns (Washington Univ., St. Louis, Mo.), N. R. Brewster, D. J. Fixsen, T. L. Garrard (California Inst. of Tech., Pasadena.), M. H. Israel (Washington Univ., St. Louis, Mo.), J. Klarmann, B. J. Newport (California Inst. of Tech., Pasadena.), and E. C. Stone *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 4 p (For primary document see N86-31483 22-93)
(Grants NAG8-498; NGR-05-002-160; NGR-24-005-050; NGR-26-008-001)
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An observation of the abundances of cosmic-ray lead and platinum-group nuclei using data from the HEAO-3 Heavy Nuclei Experiment (HNE) which consisted of ion chambers mounted on both sides of a plastic Cherenkov counter (Binns et al., 1981) is reported. Further analysis with more stringent selections, inclusion of additional data, and a calibration at the LBL Bevalac, have allowed the determination of the abundance ratio of lead and the platinum group of elements for particles that had a cutoff rigidity R(c) > 5 GV. The observed ratio for Pb/Pt is distinctly lower than that predicted by any of the standard models for cosmic ray sources. It is possible that the difference is not an indication that the cosmic ray source composition is greatly different from that of the solar system, but rather that there is less Pb in the solar system and in the r-process than is assumed in the standard models. M.G.

N86-31517*# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
AUTOMATED SCANNING OF PLASTIC NUCLEAR TRACK DETECTORS USING THE MINNESOTA STAR SCANNER
P. J. Fink and C. J. Waddington *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 4 p (For primary document see N86-31483 22-93)
(Grant NGR-24-005-050)
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The problems found in an attempt to adapt an automated scanner of astronomical plates, the Minnesota Automated Dual Plate Scanner (APS), to locating and measuring the etch pits produced by ionizing particles in plastic nuclear track detectors (CR-39) are described. A visual study of these pits was made to determine the errors introduced in determining positions and shapes. Measurements made under a low power microscope were compared with those from the APS. M.G.

N86-31518*# La Paz Univ. (Bolivia).
COSMIC RAY ANISOTROPIES AT HIGH ENERGIES
N. J. Martinic, A. Alarcon, and F. Teran *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 4 p (For primary document see N86-31483 22-93)
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The directional anisotropies of the energetic cosmic ray gas due to the relative motion between the observers frame and the one where the relativistic gas can be assumed isotropic is analyzed. The radiation fluxes formula in the former frame must follow as the Lorentz invariance of dp/E, where p, E are the 4-vector momentum-energy components; dp is the 3-volume element in the momentum space. The anisotropic flux shows in such a case an amplitude, in a rotating earth, smaller than the experimental measurements from say, EAS-arrays for primary particle energies larger than 1.E(14) eV. Further, it is shown that two consecutive Lorentz transformations among three inertial frames exhibit the

violation of dp/E invariance between the first and the third systems of reference, due to the Wigner rotation. A discussion of this result in the context of the experimental anisotropic fluxes and its current interpretation is given. Author

N86-31519*# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.

HIGH ENERGY ELECTRONS BEYOND 100 GEV OBSERVED BY EMULSION CHAMBER

J. Nishimura, M. Fujii, A. Yoshida, T. Taira (Kanagawa Univ., Japan), H. Aizu (Kanagawa Prefectual Coll., Japan), Y. Nomura, T. Kobayashi (Aoyamagakuin Univ., Tokyo, Japan), M. Kazuno (Toho Univ., Tokyo, Japan), A. Nishio (Kyoto Univ., Kumatori, Japan), R. L. Golden (New Mexico State Univ., Las Cruces) et al *In* NASA: Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 4 p (For primary document see N86-31483 22-93)

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Much efforts have been expended to observe the spectrum of electrons in the high energy region with large area emulsion chambers exposed at balloon altitudes, and now 15 electrons beyond 1 TeV have been observed. The observed integral flux at 1 TeV is (3.24 + or - 0.87)x10(-5)/sq m sec sr. The statistics of the data around a few hundred GeV are also improving by using new shower detecting films of high sensitivity. The astrophysical significance of the observed spectrum are discussed for the propagation of electrons based on the leaky box and the nested leaky box model. Author

N86-31520*# National Center for Atmospheric Research, Boulder, Colo. High Altitude Observatory.

DIFFUSIVE ELECTRON ACCELERATION AT SNR SHOCK FRONTS AND THE OBSERVED SNR RADIO SPECTRAL INDICES

T. J. Bogdan, M. A. Lee (New Hampshire Univ., Durham), I. Lerche (South Carolina Univ., Columbia), and G. M. Webb (Arizona Univ., Tucson) *In* NASA. Goddard Space Flight Center Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 4 p (For primary document see N86-31483 22-93)

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The radio synchrotron emission from relativistic electrons in shell supernova remnants (SNRs) provides a unique opportunity to probe the energy distribution of energetic electrons at their acceleration site (SNR shock fronts). This information provides insight into the acceleration mechanism(s). The implications of these observations for the diffusive (first-order Fermi) acceleration of electrons at the SNR shock fronts are discussed. M.G.

N86-31521*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ELEMENTAL ABUNDANCES IN COROTATING EVENTS

T. T. vonRosenvinge and R. E. McGuire *In its* Nineteenth International Cosmic Ray Conference. Conference Papers: Invited Rapporteur, Highlight, Miscellaneous, Volume 9 Feb. 1986 2 p Prepared in cooperation with Maryland Univ., College Park (For primary document see N86-31483 22-93)

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Large, persistent solar-wind streams in 1973 and 1974 produced corotating interaction regions which accelerated particles to energies of a few MeV/nucleon. The proton to helium ratio (H/He) reported was remarkably constant at a value (22 + or - 5) equal to that in the solar wind (32 + or - 3), suggesting that particles were being accelerated directly out of the solar wind. Preliminary results from a similar study approximately 11 years (i.e., one solar cycle) later are reported. Corotating events were identified by surveying the solar wind data, energetic particle time-histories and anisotropies. This data was all obtained from the ISEE-3/ICE spacecraft. These events also show H/He ratios similar to that in the solar wind. In addition, other corotating events were examined at times when solar flare events could have injected particles into the corresponding corotating interaction regions. It was found that in these cases there is evidence for H/He ratios which are significantly different from that of the solar wind but which are consistent with the range of values found in solar flare events. M.G.

N86-31522*# California Univ., San Diego, La Jolla.

GRADIENTS AND ANISOTROPIES OF HIGH ENERGY COSMIC RAYS IN THE OUTER HELIOSPHERE

Walker Fillius, E. C. Roelof (Johns Hopkins Univ., Laurel, Md.), Edward J. Smith (Jet Propulsion Lab., California Inst. of Tech., Pasadena.), David Wood, and Wing-Huen Ip (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (West Germany).) 1985 4 p (Grant NAG2153)

(NASA-CR-176944; NAS 1.26:176944) Avail: NTIS HC A02/MF A01 CSCL 03B

Two cosmic rays which pass through the same point going in opposite directions will, in the absence of scattering and inhomogeneities in the magnetic field, trace helices about adjacent flux tubes, whose centerlines are separated by one gyrodiameter. A directional anisotropy at the point suggests a difference in the number of cosmic rays loading the two flux tubes; that is, a density gradient over the baseline of a gyrodiameter. Previous studies at lower energies have shown that the cosmic ray density gradients vary in time and space. It is suggested that the radial gradient associated with solar cycle modulation is supported largely by narrow barriers which encircle the sun and propagate outward with the solar wind. If so, the anisotropy is a desirable way to detect spatial gradients, because it can be associated with the local solar wind and magnetic field conditions. Anisotropic measurements made by Cerenkov detectors on Pioneers 10 and 11 were studied. It was found that local anisotropy varies greatly, but that the long term average is consistent with the global radial gradient measured between two spacecraft over a baseline of many AU. Author

N86-31523# Universidade Estadual de Campinas (Brazil). Inst. de Fisica.

TOPICS ON COSMIC RAYS. VOL. 1: 60TH ANNIVERSARY OF C.M.G. LATTES

J. BellandiFilho and A. Pemmaraju 1984 250 p

(DE86-700674; INIS-BR-404-Vol-1) Avail: NTIS (US Sales Only) HC A11/MF A01

Some theoretical and experimental results concerning cosmic radiation works or with related ones, mainly of the Brazil-Japan Collaboration, are presented in honor of the 60th anniversary of C.M.G. Lates. DOE

99 GENERAL

N86-31524*# National Aeronautics and Space Administration, Washington, D.C.

ASTRONAUTICS AND AERONAUTICS, 1977: A CHRONOLOGY

Eleanor H. Ritchie 1986 323 p

(NASA-SP-4022; NAS 1.21:4022) Avail: NTIS HC A14/MF A01 CSCL 05D

This publication is a chronology of events during the year 1977 in the fields of aeronautical and space research, development, activity, and policy. It includes appendixes, an index, and illustrations. Chronological entries list sources for further inquiry. Author